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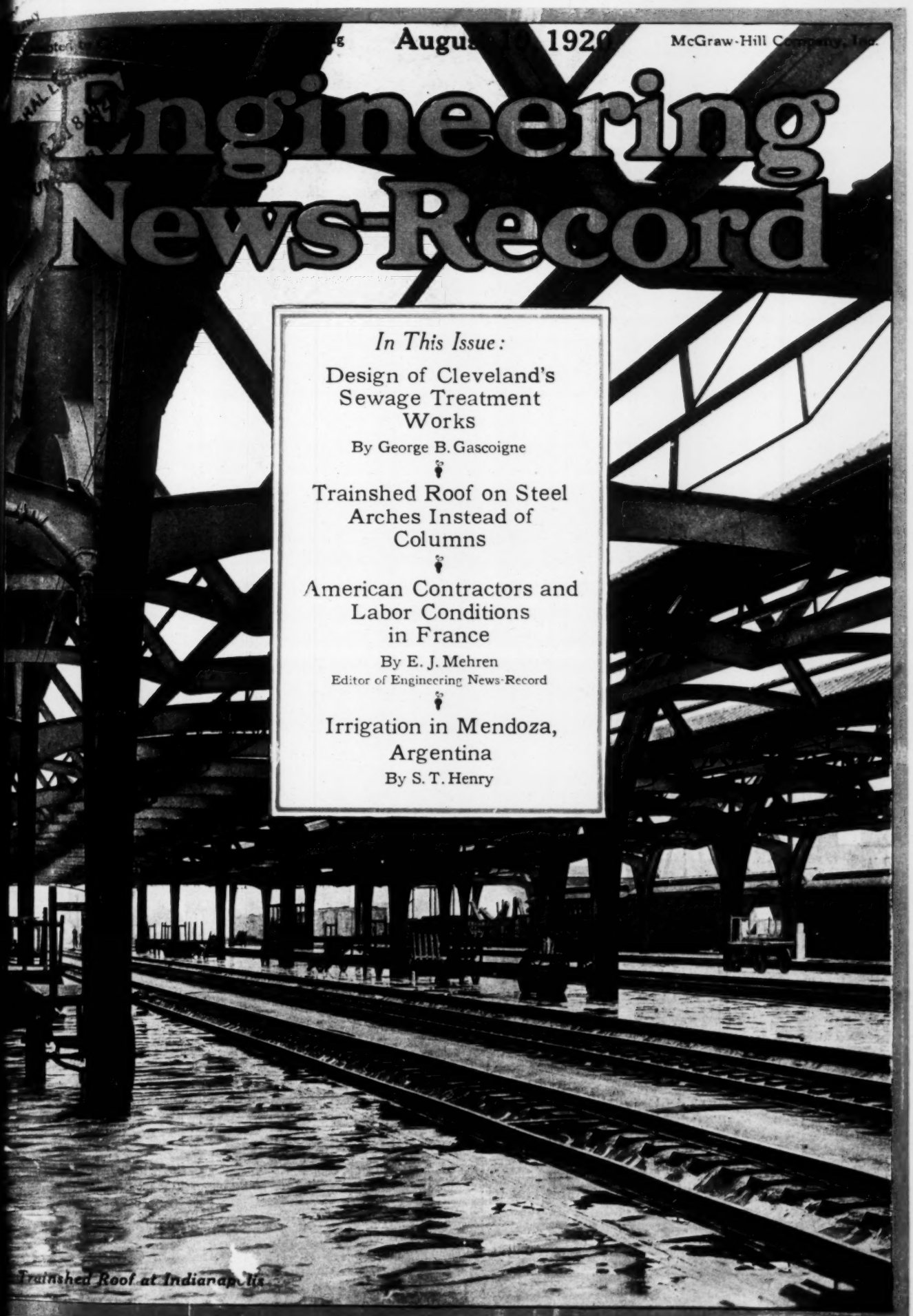

Trainshed Roof at Indianapolis

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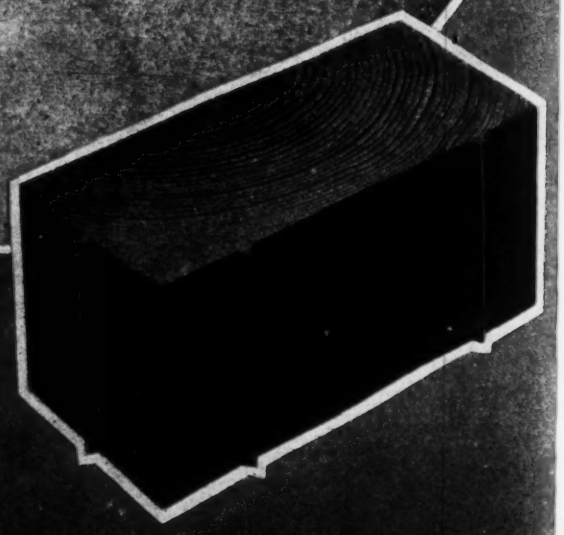

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 85 — NEW YORK, THURSDAY, AUGUST 19, 1920 — Number 8

Concrete for Rats

THREAT of bubonic plague is leading the health officers of New York, Philadelphia and other cities to make a vigorous campaign against rats. Always a serious economic drain because of their heavy toll on foodstuffs, rats become a cause of alarm when bubonic plague reaches our seaports, as it has done recently. Rat extermination is the order of the day, under such conditions. Concrete rat stops and concrete instead of wood structures along the waterfront are efficient and permanent measures against rats that should be supported by all good citizens and leaders of civic thought and action in rat infested communities.

The Ethics of Promotion

ARE the ethics of promotion like snakes in Ireland—notable by their absence? The discussion may well be limited here to the sort of promotion encountered by engineers in municipal practice and be further confined to those cases where an engineer thoroughly conversant with his field has been engaged to prepare plans for a specific piece of improvement and has submitted the plans for final approval. He has studied every aspect of the case and out of many methods which somewhere have served well to do the work in hand he has selected the one which his experience and his cost estimates indicate will, under local conditions, produce the desired result at the lowest cost, or perchance the best results at a reasonable cost. At this juncture the promoter arrives. He has a single proprietary method or apparatus for doing work which can be done more or less well and expensively by various methods or apparatus. All these possibilities, or the most promising of them, have been canvassed by the engineer, and his choice, as already indicated, has been made. Has the promoter any code of ethics to serve as a guide in such cases and if so, what is it?

City or Contract Work

WEIGHED in the balance by three engineers, the advantages and disadvantages of city cleansing at Philadelphia by municipal as against contract forces show a decided tip of the scales for municipal work, as may be seen by extracts from the report printed on p. 357. This, as the full report shows (see *Journal* of the Engineers' Club of Philadelphia for August) is in line with the conclusions reached and put into practice by other large cities of the country—particularly as regards street cleaning and in lesser degree as to refuse collection. As we pointed out last week, the reform administration at Philadelphia will be judged, both as to good intent and ability, by the way it handles its city cleansing problems of the coming year. Engineers stand ready to see that the work is done honestly and efficiently. The question at issue is, do those who have the decision as to ways and means care most for good work at the lowest possible price or for whether it is done by a contractor of this or that political faction? The answer to this question is more important than whether the work is to be done by contract or by the city direct, although the people of Philadelphia have reason to suppose that direct city work was virtually decided on when the new charter was enacted and made sure when the present administration came into power.

Housing to the Front

THE housing shortage is emphasized anew by the announcement that in the month of July plans for only one apartment house and for one dwelling were filed in Manhattan Borough, New York City, and by the calling by Governor Smith of a special session of the New York legislature to deal with the serious housing shortage in the cities of the entire state. The subject is also to come up again soon in an adjourned session of the New Jersey Senate. It has been given serious attention by the authorities of New York, Jersey City, Newark, Providence and other cities for months past. State and city action on housing is so new in this country, and the housing problem here is so acute and so complex, that attention may well be given to a couple of books on housing reviewed on p. 370. No one responsible for reaching a decision as to how to meet our housing problem should fail to read the British book, since it details years of governmental experience in England, as well as the elaborate Parliamentary acts and the administrative procedure under them. The American book is well worth reading, but its contents are stimulating rather than of direct practical application—or perhaps one should say of immediate general application, along the lines urged by its author. The housing problem comes home to the engineer because of the certain reaction of the demand for so much labor, material, transportation and capital upon construction activities more in his domain and also because the engineer must take no small part in sharing the problem if it is to be adequately and quickly solved.

Railway Rate Reactions

NEXT week the new railway rates go into effect. There is division of opinion as to their reaction on the ultimate consumer, but most people expect that the public will bear not only the increased rates but several accretions of added charges as well. The only argument to the contrary worth considering is that with higher rates the railway will give so much better service that production costs will fall and profits rise, but the past few years have made the average citizen skeptical of the immediate reaction of economic laws. The instinct to get while the getting is good seems farther than ever from being overcome. Consequently, the

skeptics believe that even if the higher rates should decrease production costs the producers will still find a way to pass on to the consumers the whole of the increase of rates—probably with something added, as has already been suggested. Regardless of this, it should be remembered that months and in some cases years will be required to convert the increased rates into better service, even assuming that they do make possible large loans for construction and equipment. It will take time to negotiate loans, get new cars and locomotives, provide better roadbed and track and larger terminals. The rise in rates is immediate. The improvements in service will come slowly and their effect upon general production will be slower yet. The one thing that ought to be improved immediately is the morale of the men and the management, which have been at low ebb. With higher wages and increased rates there should be betterment in both, with consequent better service. The public, certainly, will not be disposed much longer to take excuses which in the past year have sometimes seemed to be only a substitute for effort. Even with a better morale all around, there is danger of a rise in prices for commodities and services due to higher rates that will be not a fraction but a multiple of the rate increases. Public opinion alone can afford protection against that. Unfortunately the public is unorganized and has no agent that can reach out quickly and surely to put down the ubiquitous gargentuan profiteer.

Economy May Mean Spending

NEARLY every proverb has its antithesis. Thus, on the one hand there is the advice to "do the best with what we have" and on the other it is urged that "the best is the cheapest." The conflict between these contrasting lines of policy in engineering work is suggested by discussions at the annual meeting of the mechanical section of the American Railroad Association. It appears that in many cases the policy of utilizing old plant and following old methods is being carried to a point where it results in direct waste and loss. The common reason or excuse assigned is inability to obtain money. But under the conditions noted it should not be difficult to demonstrate conclusively that small immediate expenditure may mean a direct and continual saving. Have the men with the knowledge and responsibility failed to make this demonstration successfully?

In car repair work, for instance, it is still common practice to have gangs of men with jacks raise the car bodies from the trucks, a slow and troublesome job. If this was occasional work the practice might be justified, but it is work that goes on day after day, year in and year out. An overhead crane or gantry would do the work in less time and with fewer men, while the men would put in their time on productive repair work instead of non-productive hoisting. The same conditions may be found in some locomotive repair shops, where small and old machines are strengthened, modified or coaxed to do the necessary work of modern equipment. In some cases this may be true economy. But in many more cases it means loss of time and energy, high cost of work and waste of material spoiled or given ineffective treatment.

These conditions are not peculiar to the railways but occur more or less in all lines of industry. In construction work, for example, there is frequently a tendency to use old or inadequate equipment in order to save expense. But if this results in delaying the work by breakdowns or insufficient capacity, the financial loss may far exceed the cost that would have provided more satisfactory equipment, to say nothing of the worry, friction and possible ill feeling between the contractor and the engineer or owner. In rarer cases there is the unnecessary expense of special employment, the cost of which is not justified by the work or the results. Such excess of plant may prove a losing investment.

What is needed is more careful exercise of judgment as to the relations between the plant and the work, as well as the relative economy of saving and spending, with a wider realization of the fact that direct saving may result from spending and that avoiding expense is not necessarily economy. In other words, a more judicial balancing of the opposing policies of "make it do" and "get something better."

Educate the Concrete Foreman

THERE is probably a wider gap between theory and practice in the making and placing of concrete than in any other field of engineering endeavor. For years past the pages of technical journals and of engineering society proceedings have been full of discussions of the technique of concrete. Quality and grading of material have been studied without end and the results of these studies placed before the profession. Insistence on certain proper methods of manufacture is the commonplace of all concrete literature and the evil effects of neglect of all the well known rules—or rather the increased effectiveness of concrete placed according to these rules—have been hammered home again and again. And yet one hour spent on almost any concrete job will show consistent violation of some of the principles which theoretically are universally accepted.

These violations are not as a rule major mistakes. It is rarely, for instance, that today we find rank skinning of cement which was common some years ago. They are such things as short-time mixing and more particularly careless measuring of material. There is no intention on the part of the foreman of saving money at the expense of the concrete but rather a lack of appreciation of the niceties of concrete manufacture. To him it is not the balanced conglomerate of the laboratory, whose strength rises or falls with small variations of content or procedure, but a mushy material which some days later, when the forms are stripped, appears as a hard stone, which can be porous and pitted if very poorly made but which as a rule is of unknown but sufficient strength. Concrete testing 1,500 lb. at 28 days does not look any different in the structure than that testing 2,500 lb.

In other words, in spite of the investigations and cogitations of engineers, the finished concrete still remains largely the product of the foreman and the inspector. These men need more education into what may truly be called the mysteries of concrete, and furthermore the manufacture of concrete should be made more and more an automatic process, so that the personal vagaries of the workman and his boss cannot affect it. In these days of $3 to $4 cement and $2 to $3 aggregate, every little saving of material helps. If by constant watching or by automatic control a sufficiently

strong concrete can be consistently produced with less costly material the effort is worth while.

It has been the fashion to disparage the efforts of the so-called "laboratory experts" to produce a better concrete. Those who have done so recognize the conditions under which most concrete is placed. They despair of ever getting a concrete gang to follow the rules other than those established by years of practice. The time has come, though, when engineers ought to consider whether the practice of the concrete gang can not be reformed, whether it is not possible regularly to measure and control the mix to a far closer degree than is now common. Engineers and laboratory men can select proper materials and specify proper methods. Only the man on the job can make sure they are regularly used or followed. And the man on the job needs to be impressed with the fact that concrete strengths vary and vary decidedly with methods and materials. He must be persuaded some way or other that a solid appearance does not necessarily mean a satisfactory strength.

Most concrete that is placed stands up under the service required by it. Long ago it was found that it would take more abuse than any other material. But the price of concrete today is so high that it behooves all who are using it to consider whether by more careful methods—and mainly by more care and knowledge on the part of the man actually placing the concrete—it would not be possible to cut down the factor of safety in design and to insure more nearly than now the adherence to a predetermined strength. Some of the large users of concrete are appreciating this necessity for getting right down to the concrete worker and are being repaid in consistently good concrete. The general user can benefit by their lesson.

Civil Engineers to Have Referendum Vote on Society Federation

DEVELOPMENTS at the annual convention of the American Society of Civil Engineers held in Portland, Ore., last week, as reported in further detail in the news section of this issue, point to an early decision of the question whether or not that organization will join the Federated American Engineering Societies. This is good news. It is now almost three months since the Organizing Conference, at Washington, D. C., laid the foundation for the federation. Since that time there has been ample opportunity for members of the profession to inform themselves as to the basis of organization and general objects of the new body. Nothing is to be gained by delaying, longer, a decision on this important question, particularly in view of the fact that the first meeting of the American Engineering Council, the directing body of the federation, is scheduled for November. As matters now stand two local engineering societies, Dallas and Detroit, and two national bodies, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, have definitely accepted the invitation to become charter members of the federated societies. Action by the electrical engineers took place Aug. 12, when the board of directors passed a resolution accepting membership in the federation and pledging the co-operation of the society to its work. Of the four founder societies, therefore, the civil engineers and the mining engineers still remain to be heard from.

Apparently when the board of direction of the American Society of Civil Engineers met at Portland on the day before the convention opened there was some doubt as to the legal status of the society's joining the federation, and action was taken to defer the referendum vote until the opinion of the organization's legal counsel could be secured. The convention itself, however, by an overwhelming vote, overruled this decision and indicated clearly that the wish of the membership was for the submission of the referendum ballot "at once." Deferring to this expression of opinion the board of direction, in a later resolution, instructed the secretary of the society to send out the ballot without waiting for legal advice.

The decision of the civil engineers, therefore, unlike that of the electrical and mechanical engineers, whose directorates acted for the respective organizations, will be based upon a representative vote of the rank and file. This being the case, it is the duty of every corporate member, as has been emphasized by this journal in past editorials, to familiarize himself with all phases of the federation question in order that he may cast his vote intelligently. The attainment of this object is clearly sought by the board, for with the referendum ballot it is proposed to send to the members carefully prepared arguments for and against the federation, together with a copy of the constitution and by-laws of the new body. A very full report of the Organizing Conference in Washington, D. C., at which the federation was formed, was published in *Engineering News-Record* of June 10. This report contained also a digest of the constitution and by-laws approved unanimously by the delegates. Since that time considerable space has been given to editorials and news articles dealing with this subject. Added to this material will be the American Society of Civil Engineers' arguments pro and con. With this mass of data available, therefore, there is no excuse for the engineer who has not an opinion on what the society's policy should be and who does not express that opinion by sending in his ballot.

The previous referendum ballot of the civil engineers on the question of endorsing the "comprehensive organization" proposed by the Joint Conference Committee produced a total vote of 3,821, or about 45 per cent of the membership entitled to vote. It is hoped that an even more general expression of opinion will be elicited by the vote on the question of joining the federation. Figures from the office of the secretary of the American Society of Civil Engineers indicate that on Aug. 10 there were 8,948 corporate members entitled to vote on the referendum, this number including those in the grade of "Member" and "Associate Member," but excluding "Junior." On the previous referendum ballot on the acceptance of the federation principle, canvassed April 14, the vote was very close, the proposal being defeated by 1,954 to 1,867, or a margin of 87 ballots.

Time and again engineers have been accused of utter indifference to questions involving the public welfare and their own interests. It remains to be seen, therefore, whether the decision as to charter membership in the Federated American Engineering Societies is regarded as of sufficient importance to bring out a vote from more than 45 per cent of those entitled to cast ballots. Unless civil engineers dodge a clear responsibility, a much heavier vote should be polled on the coming referendum than on the past one.

American Contractors and Labor Conditions in France

BY
E. J. McHenry
EDITOR ENGINEERING NEWS-RECORD

WHY have not American contractors participated in the rebuilding of the devastated regions of France? There were predictions at the time of the Armistice of great opportunities for them. Few of these opportunities have been realized. There are a number of reasons:

(1) The French want to rebuild according to French ideas, having regard also for the traditions of the ruined cities. These ideas are incompatible with the mass production proposed by some American contractors.

(2) The French have a pride in their ability to carry on construction. They resent the suggestion that they need help. There is, so far as I can learn, only one construction company here that represents American capital—and it is, in reality, a French company manned by French engineers and contractors. There are only three Americans in a responsible force of probably 50.

MILES OF AMERICAN PATENTED CAST-IRON PIPE IN GOVERNMENT BUILDING MATERIAL PARK AT ARRAS

(3) Construction can be taken in hand only so fast as the damages can be determined. This is an enormous task and necessarily can proceed only as rapidly as the relatively limited number of commissions of qualified men, familiar with local conditions, can work. With the fluctuations in wages and material prices, too, these damage credits are subject to frequent change. Under the law, an owner who rebuilds within 50 km. of the original site is paid the reproduction value as of the present date. Necessarily the estimate must be revised if wages and material costs change. A 20 per cent credit is wanted as soon as the damages are determined, and other advances made as the work proceeds. If an owner chooses not to rebuild, or to rebuild at a distant point, he receives damages based on values in 1914.

(4) The French Government wisely decided to concentrate on work in the order of its economic importance: First, the reclamation of the land, and the erection of temporary dwellings, then the restoration of the building-material industry, followed by the reconstruction of factories and the construction of permanent dwellings. The last feature has hardly yet been taken in hand. Therefore, plans for rebuilding whole towns in permanent construction were not in order early in 1919 and are scarcely in order today.

(5) Building materials are scarce and must be distributed so that in all districts and towns progress may be at about the same rate.

There are other reasons, but these are the really important ones.

CANADIAN MONUMENT AT VIMY RIDGE

It is worth noting that the financing of work was not referred to until the question was raised by the visitor. In other words, the various factors above mentioned have always disposed of the American contractor before the question of finance was reached. The traditional position that all flows to the man with money did not hold here. Of course, France would still like to have American credits, but only to allow them to pay for raw material when the exchange has returned to normal or materially improved.

Financing of Contracts

The financing of contracts is, nevertheless, a matter of grave importance, but not due to failure to get estimates promptly, but to the necessity of carrying a large material supply. This applies to the relatively large operations—not to the building of one or two small dwellings, for which material is secured from the Government material depots. The root of the trouble is a combination of inadequate transportation facilities and material shortage. One must wait 3 months for deliveries. Consequently, the larger contractors are following the practice of taking work only in a given locality and carrying there large stocks, which are delivered to the building sites with their own truck fleets. The capital required is about 50 per cent of the amount of work done in a year. Sub-contracting, with the upset conditions, is very unsafe. For that reason most contractors do all the work themselves, and even go so far as to make the window frames, doors and trim in their own shops.

Material, it should be said, is paid for only after it has been built into the job.

Contracts are all on a unit-price basis, the bid price being considered a base price which is adjusted every three months in accordance with the fluctuations in labor and material prices. The contracts are made with individual owners or, for dwellings, with co-operative building societies, the membership of which is composed of those whose damages have been determined by the Government commissions. One may get a contract to build a whole village but, unless one wishes to carry the risk, only if the appraisal work has been finished and the owners have all joined the co-operative society.

TEMPORARY RAILROAD STATION AT LENS

The Government advances go into the treasury of the society, which, in turn, pays the contractor.

There is still much work to be done. In fact, only a beginning has been made, but the work is not likely to be done by American contractors. If they have capital to be employed they may use it in France if they want to lose their identity, and organize as a French company with French officials. Even then they will not get work, or succeed in what they get, unless they are willing to respect French customs and acquire some of that French tact to which we are largely strangers.

The last remark is made advisedly. Many who come here carry a superior air. It is naturally and rightfully resented. "I will bring a hundred Americans over here and show you how to do construction work," was said by the representatives of a strong American company to a French official. What chance would that organization have to get work, no matter how heavily its arms were laden with gold? I could cite other cases of boorish assertion of superiority—but this case will suffice. Our help will be welcome; but we must come here to help only. The French must do the work in their way. That does not mean that American construction methods cannot be used; they can be, if tactfully proposed and where conditions are suitable.

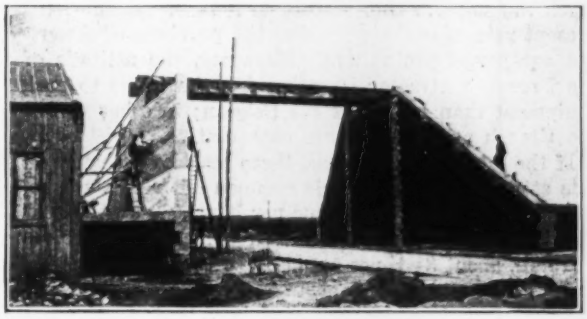
With reference to the reconstruction it is to be noted that it is proceeding much more rapidly than the work in Belgium. There only work in the cities and towns is proceeding. Such is not the case in France. Work of every kind is going forward and the progress is rapid.

Labor Conditions

A previous article also pointed out that labor conditions in the devastated regions are good. Wages are high but the men are working hard.

In the other parts of France conditions are not so favorable, but the recent improvement has been such that a decidedly optimistic tone has developed among the manufacturers, just as it has in Belgium. This optimism has developed largely because of the failure of the May-day strike.

The Confederation Generale du Travail, the French organization corresponding to our American Federation of Labor, had, previous to the war, been quite radical. During the war heavy responsibilities were imposed on the leaders, and, as usual, caused them to modify their program. At the same time, the war was a breeder of radicalism among the younger men. So strong did they become that the leaders were obliged, finally, to condone radicalism (just as Gompers did with us) or lose their jobs. The radical group felt they were ready for the test in May. The plan was nothing short of a social revolution, the establishment of the "Fourth Republic", with the workers in control. The strategy, so the radicals thought, was carefully worked out. There were to be successive "waves" of strikes until the government capitulated—first the railroad men were to strike, then, in succession the steel workers, the stevedores, etc. The strategy got no farther than the third wave, the stevedores. Very shortly it became apparent that the radicals were wrong in their calculations, that they did not have the majority of French workmen with them. Even on the railroads, the critical industry, the strike was not popular, except possibly on the Government railway system, the *Etat*. The proposed steel strike was a flat failure, the stevedores' strike somewhat more successful. For three weeks the losing fight was kept up, and when the C.G.T. called it off it was in hopeless defeat.



REBUILDING BRIDGE NEAR LENS

This it is that has produced the optimistic tone in France. It has been clearly demonstrated that the French worker proposes to stick to a sane economic system, that he will not turn Bolshevistic.

Since the strike, too, efficiency has increased materially. The workers show a better spirit. Evidently they have concluded that their own best interests are served by doing a good day's work.

The French workers, by the way, probably have less cause to complain than those in any other country. Wages have gone up in the same proportion as living costs—about 3½ times. Nevertheless, here as elsewhere, there has been a decrease in efficiency. In fact the 8-hour day is now required by law, though it is by common consent not observed in the devastated regions.

Employers' Attitude

As indicative of the liberalizing of the views of employers, formerly quite conservative, one movement gaining strength here may be noted—a plan whereby married men are paid more for the same work than unmarried men. The plan is administered through associations, each embracing all the industries of one kind in a given district. Each employer pays into the association's treasury weekly a given sum per employee. Out of this fund the married men are paid the extra wage. The amount varies somewhat in different districts, but is approximately 200 francs on the birth of a child and 20 francs per week for each child in the family. The plan is administered through associations not merely to give it greater stability but to insure the payment of the same extra ratio through the given industry in the given district.

Remarking upon the unusual character of the scheme and its negation of the "uniform pay for uniform work" slogan, I was met with the rejoinder, "We apply the differential in income taxation; why not in business? If the differential is sound in taxation, it is so in business."

Incidently the plan does not find favor with the C.G.T., for it tends to make the married man even more steady and unsusceptible to radical propaganda than he is today. What the radicals in the C. G. T. want is a large following of unattached men who will follow wherever the leaders wish to go.

American Construction Plant

Reference to industrial conditions naturally tempts one to inquire as to the prospects for the use here of American construction machinery. The situation is much the same in this respect as it is in Belgium: the present rate of exchange makes the purchase of American equipment prohibitive. Moreover, the attitude of the French contractor is rather less favorable to such equipment than is that of the Belgian; in other words, the French are rather more conservative.

If the labor costs stay up, there may be a change in this attitude. Around Paris common labor received before the war about 0.60 franc per hour (60 centimes or about 11½ cents at normal exchange). Now it receives 2 francs, about 3½ times as much. In the provinces the comparative rates are about 40 centimes and 2.35 francs, respectively. Skilled labor that received 1 franc before the war gets about 3.50 francs now. The French contractor is shrewd and able. He did not use machinery before because hand labor was more economical. If machinery can effect economies he will come to its use, though he will be sure of every step before he proceeds. Conservatism is the rule here.

Paris, June 15.

Influenza Halts Alaska Railway Work

AN EPIDEMIC of influenza in April disorganized the construction forces on the northern division of the Alaskan Engineering Commission. The following notes are abstracted from the monthly report of Frederick D. Browne, engineer in charge:

On the Chatanika branch, at the steam shovel camp at Bridge No. 5, of fifty-two men at work but eight remained who did not require medical attention. The work was discontinued, with one man only left on the payroll to care for the rolling stock, steam shovel, etc., in addition to a cook and helper who remained. The pile driving crew was also disorganized. There is no doubt that a couple of weeks at least will intervene before we get back into our regular stride.

On May 1 there was no communication permitted between Fairbanks and Nenana, as there is a possibility that one of these infected districts will be purged of the scourge before the other district, and by intercommunication there is possibility that reinfection might occur. The epidemic seemed to sweep through all parts of the northern division. Whole contractors' camps have been abandoned, perhaps leaving a single caretaker. The influenza has not confined itself to any one class of men, but has gone through the clerical and engineering forces, as well as the laborers and stationmen. No fatalities have occurred, nor do we anticipate any.

On May 1 the hospital was filled to capacity. The Cooney Hotel and one of the dormitories are nearly full. The native Indian village, including the missionaries has over thirty prostrations.

Test of Timber Posts with Warp and Seasoning Cracks

By Tom W. Greene
Assistant Engineer Physicist, U. S. Bureau of Standards, Washington, D. C.

THERE has been some question as to the effect of cracking and warping due to the seasoning of timber on the strength of wooden columns. In the hasty construction of the temporary war buildings in Washington, D. C., during the war, it was necessary to use a large number of columns of unseasoned timber. In the process of drying out or seasoning, a large number of these columns developed seasoning cracking and warping. Some inspectors contended that these columns were not safe, so one good column and four columns representing the different conditions that had developed by seasoning were taken from a building and tested at the Bureau of Standards.

4 x 8½ VIRGINIA PINE POST CRACKED IN SEASONING

One of the columns was straight but full of large seasoning cracks; three were bent, the maximum deflection from the perpendicular being 1⅜ in., 1⅛ in. and ⅞ in.; and one was in sound condition with no bending or cracking. The columns, 4 x 8 in. Virginia pine timber about 8½ ft. in length were tested as taken from the building, after the ends had been carefully squared for the flat heads of the testing machine.

The test showed that seasoning cracking alone does not appreciably affect the strength of straight columns. The column tested for this condition was an excellent sample of unusually severe seasoning cracking, one large crack about ½ in. wide extending nearly the whole length of the timber, having practically split the column, as shown in the view. This column showed greater strength than the sound column, which was probably due to the fact that the timber was in better condition, having a lower moisture content and higher specific gravity. It is to be expected that seasoning cracking of this nature would not materially weaken a column where the plane of cleavage is parallel to the plane of least dimension.

4 x 8½ VIRGINIA PINE POST CRACKED IN SEASONING
TESTS OF SEASONING CRACKED WOOD POSTS
4 x 8-In. by 8½-Ft. Virginia Pine

Column No.	Average Moisture Content, per Cent	Average Specific Gravity	Ultimate Strength, Lb.	Condition of Columns Taken from Building
1	97	11.0	0.61	116,300	Sound condition, no cracking or bending
2	100	10.0	0.64	137,000	Straight but full of large seasoning cracks
3	100	9.8	0.58	36,000	Warped maximum deflection at center 1⅜ in. from straight axis.
4	85	10.2	0.62	57,500	Warped, maximum deflection 1⅛ in. at one-third the distance from end
5	97	9.4	0.50	72,000	Warped and twisted, maximum deflection ⅞ in. at center.

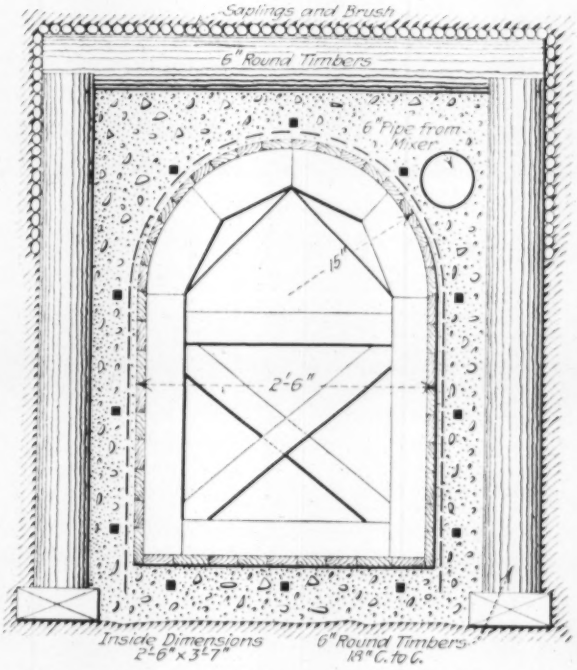
Any bending or warping produced by seasoning, however, considerably weakens a column. Two of the three bent columns which were tested showed about

e-half the strength of a straight column and one had s than one-third the strength, which would render unsafe for use. The weakest column and the maximum bend, the camber at the center in the plane of ast dimension being 1⅛ in. A small increase in e deflection from the perpendicular due to warping aterially reduces the strength of a column as shown n the accompanying table. The table contains the data or the ratio of length to least radius of gyration, verage moisture content, average specific gravity, ultimate strength, and condition of the column tested.

Small Tunnel Lined By Pneumatic Method

By H. B. Kirkland
President, Concrete Mixing & Placing Co., Chicago

PNEUMATIC concreting of a small tunnel only 30 x 43 in. in net section and with a 6-in. lining was accomplished recently under difficult conditions at La Salle, Ill. This was a sewer tunnel about 280 ft. long for the Marquette Cement Manufacturing Co., and was in soft clay ground, with about 10 ft. cover and passing under mill buildings where heavy machinery was in operation.



SMALL TUNNEL CONCRETED WITH PNEUMATIC MIXER

The rectangular excavation was lined with square sets of 6-in. round rough timbers spaced about 18 in. c. to c., the roof and sides being covered with saplings and brush.

When the tunnel was completed and timbered, the forms for the lining were erected for a length of 30 ft. at one end and steel reinforcing bars were laid as shown, being supported on blocks in the sides and floor. With these bars in place there was very little room for inserting the delivery pipe for concreting. In fact the only point available was over the haunch on one side of the arch. As this 30-ft. length of 6-in. steel pipe weighed about 400 lb. and had bolted flange joints it was highly desirable to concrete the entire section at one setting of the pipe.

The pneumatic mixer was somewhat at a disadvantage under these conditions, partly because the pipe was below the highest point of the concrete to be placed and also because the opposite side of the form had to be filled from this one position of the pipe. Under the momentum of its discharge, however, with a pressure of 80 to 100 lb. in the delivery pipe, the concrete was forced over the crown of the arch, after the floor, wall and haunch on the pipe side had been filled, the weight of fluid concrete on the opposite side being sufficient to make it flow under the bottom form and so complete the floor lining.

In operation, the rear 15-ft. length of the form was filled first, the delivery pipe being then shortened and the concreting completed up to the forward bulkhead. It took about two hours to fill one 30-ft. length, with one man at the delivery pipe, one operator at the mixer, and five men to charge the mixer. A 1: 2½: 5 mix was used, with gravel aggregate of 1½-in. size. The men worked one 8-hr. shift each day and could place concrete at the rate of one ½-yd. batch per minute. When one section was completed, another 30-ft. length of form was erected, the end bulkhead of the first form removed and the concrete placed, these operations being repeated until the portal was reached. Each form was left in place for 24 hours. Progress was delayed by flood water backing up into the tunnel.

This work was done by day labor under the supervision of Richard Moyle, superintendent for the cement company. An experienced man of the Concrete Mixing & Placing Co., Chicago, makers of the pneumatic mixer, supervised the operations.

Co-ordination of Activities of State Health Engineers

AT THE recent conference of State and Territorial Health Officers with the U. S. Public Health Service at Washington, D. C., sanitary engineers from 23 states were in attendance, or from more than half of the 42 states represented. Besides attending the general conference, the sanitary engineers met in a separate section, together with representatives of the Public Health Service. After reviewing briefly the proceedings at the section meeting, *Public Health Report* (U. S. Public Health Service, Washington, D. C.) for June 4, 1920, says:

The topic, however, of greatest interest and concern to everyone of the group of state engineers was the means for co-ordinating the engineering activities of the various states. The need for standardization of policies and exchange of experiences among the sanitary engineers in official administrative positions was considered of paramount importance for increasing the efficiency of work in this field. It was the opinion of the state engineers that very much toward the co-ordination and standardization of the activities of state sanitary engineering divisions could be effected and properly accomplished by the U. S. Public Health Service. The specific request was made to the chief of the division of domestic quarantine for the full-time detail of an engineer to collect, analyze, and report to all state engineering divisions, data on the prevailing and proposed activities in this field. For this same purpose permanent standing committees were appointed as follows: Water Supply (including laboratory procedure), W. H. Dittoe, chairman; Sewage and Steam Pollution, V. M. Ehlers, chairman; Laws, Organization, Policy, and Procedure of State Sanitary Engineering Divisions, H. A. Whittaker, chairman; Milk Problems, Theodore Horton, chairman; Mosquito Control, R. Messer, chairman; Swimming Pool Sanitation, S. De M. Gage, chairman.

The Design of Cleveland's Sewage-Treatment Works

Three Plants to Protect Bathing Beaches and Prevent Nuisances in Cuyahoga River — Gratings, Grit Chambers and Two-Story Tanks with Disinfection for Two Lake-Front Plants—Final Design of River Plant Deferred

By George B. Gascoigne
Sanitary Engineer, in charge Sub-Division of Sewage Disposal, City of Cleveland, Ohio

THE TWO large sewage-works now under construction for the City of Cleveland have several features of design which should be of interest. In discussing these, it is important, and also of interest, that the program for improving sewerage and water facilities be outlined briefly.

General Policy—For a number of years the problem of safeguarding the health of this community by purifying the water and treating the sewage, has been discussed, investigated and reported upon. A plan of procedure was eventually adopted, and is now being carried out. It provides for the construction of two large water filtration plants and three sewage treatment plants. The water plants will provide a definite control of the purity of the water supply, while the chief object of treating the sewage is, first, to protect the bathers who use the lake beaches, thereby safeguarding the public's health, and second, to correct the foul condition of the Cuyahoga River. It can be claimed, therefore, that the sewage-works are mainly necessary as a health measure on account of the existing bathing beaches, and that remedying the foul conditions of the Cuyahoga River is a matter largely of sentiment and public comfort. The present program is representative of the progressive spirit of the community and establishes a high standard of municipal sanitation.

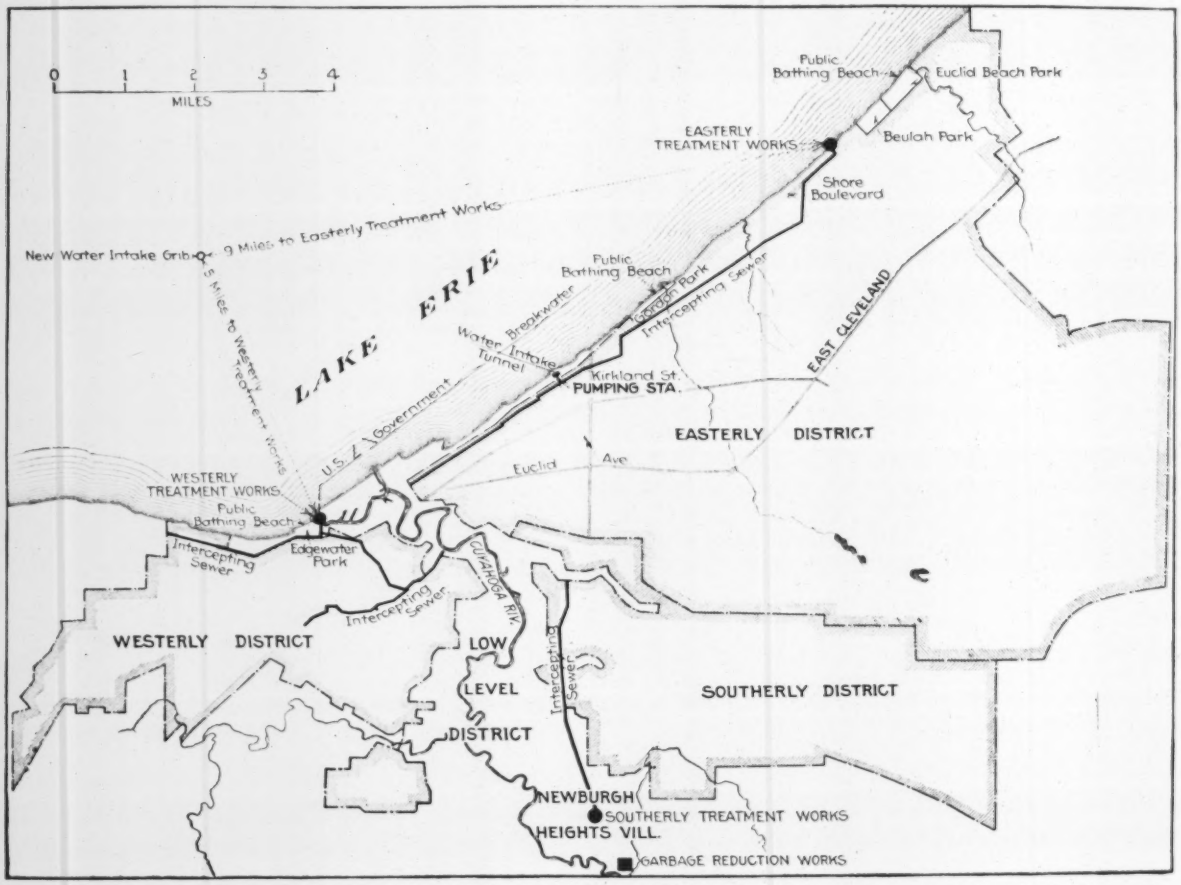


FIG. 1. LOCATION OF SEWAGE DISTRICTS, INTERCEPTING SEWERS, SEWAGE-WORKS, BATHING BEACHES AND EASTERLY SEWAGE-WORKS, CLEVELAND, OHIO

Experimental Studies.—The question of proceeding slowly with the completion of Cleveland's sewage disposal project has received considerable attention. It has seemed advisable to have a unanimity of opinion upon any steps taken and at the same time to take advantage of the latest developments of the art in order that the plants may represent the best in modern sewage disposal practice. While the idea of proceeding cautiously has existed, a determined attempt has been made to avoid unreasonable delay.

TABLE I. SHOWING SALIENT POINTS IN DESIGN OF CLEVELAND SEWAGE-WORKS

Sewerage Districts. Name	Estimated as of 1930 Area Acres	Estimated as of 1930 Population	Location of Plants	Type of Plant	Estimated Population Design	Estimated Population Served in 1920	Sewage flows as of 1930 Gallons Per Capita Daily	Sewage flows as of 1930 Normal Dry Weather M. G. Daily	Sewage flows as of 1930 Maximum Wet Weather M. G. Daily	Estimated Cost Works Complete	Estimated Cost Already Done
Westerly	9,280	311,000	W. 58th St. at Lake Front	Sedimentation in grit chambers and 2-story settling tanks; chlorination and dispersion	288,000	194,000	125	36	159	$1,100,000	$400,000
Easterly	20,620	575,300	E. 140th St. at Lake Front	Same as Westerly	575,000	422,000	160	92	1,055	$1,250,000	$825,000
Southerly	7,200	226,000	Wilcox, Ohio.	Sedimentation in grit chambers and 2-story settling tanks; oxidation in sprinkling filters	200,000		110	22	131		$300,000
Low Level	7,900	23,700	Undecided	Undecided	*			*128		$2,350,000	
TOTAL	45,000	1,136,000									

*Flow for Southerly plant omitted.

Although the art of sewage disposal is still developing, certain fundamental principles have been settled fairly definitely. In order to study these principles in their application to local conditions, it was necessary to conduct comprehensive investigations along experimental lines upon the treatment of the sewage at Cleveland. These studies have covered a wide field, in that they pertain to tests with various structures for settling sewage, for oxidizing by filtration and by dilution, for screening sewage and for its treatment by the newer activated-sludge process. Experiments were started in 1913, and to date have cost about $150,000.

Program of Procedure—Funds for constructing the treatment plants were provided on the basis of pre-war estimates but, since the work was not placed under contract until 1919, it was necessary to restrict the immediate program to the more important parts of the work, that is, treating the sewage discharged at the two lake front plants, the Westerly and Easterly, which together represent about 75 per cent of the total. At the Westerly plant the treatment will be relatively complete, while at the Easterly plant it will be partial. It is hoped by a comparison of results to establish the future necessity of providing additional treatment at the partial plant.

The City (Fig. 1) was divided into four sewerage districts, the Westerly, Easterly, Southerly and Low Level, and each district excepting the Low Level, has a main intercepting sewer to deliver sewage to the treatment site. The sewage of the Westerly and Easterly districts will be treated at two lake-front plants, while the sewage from the remainder of the city will be treated at a plant located on the Cuyahoga River, about seven miles from its mouth. Since lake water is not available at this site, it appears that ultimately structures which provide a higher degree of treatment will be necessary. Since contemplated river and harbor improvements along the Cuyahoga River involve an extensive plan for straightening the river channel, the problem of sewage disposal for the Low Level district, which bounds the river, is rendered especially uncertain at this time. As this district is occupied largely by manufacturing establishments, such as steel mills, oil refineries, lumber mills and similar industries, and contains less than two per cent of the city's population, it is considered advisable to delay the sanitary improvements until some time in the future.

Sewage Treatment Sites.—The location of the lake-front sewage disposal sites in reference to bathing beaches, parks, residences and boulevards, together with the districts which they serve, is shown in Fig. 1. Cleveland's main sewer outlets were so located in 1912 that without any additional expense it was possible to collect the sewage at three points instead of one, thereby extending considerably the useful life of the intercepting sewers. The treatment plants were therefore located at these outlets, creating a condition which emphasizes the importance of operating them without nuisances. The fact that the lake front plant sites are not well isolated has a distinct bearing upon many of the features used in the design.

Type of Plants.—In order to present in a concise form the salient points of the various sewage plants, Table I. is presented. It will be noticed that the types proposed are the same except at the Southerly site where sedimentation in grit chambers and two-story tanks is followed by oxidation in sprinkling filters. At the present time funds are not available to construct this plant, therefore a definite decision upon the type which will be used is a question for the future.

Both the Westerly and Easterly sewage plants are practically identical in respect to the types of structures, and the basis of design. The sewage as it flows into the Westerly plant will first be rough screened by means of two sets of gratings. It will then pass into the grit chambers where, by brief sedimentation, the

TABLE II. SHOWING MAXIMUM CAPACITY AND OPERATION RANGE OF VARIOUS DEVICES AT CLEVELAND SEWAGE-WORKS

Easterly Sewage Treatment Works

Treatment Devices	Flows in M.G.D. Operating Range	Flows in M.G.D. Maximum Capacity
Main intercepting sewer		400
Collinwood sewers		655
Main interceptor by-pass	0–190	260
Collinwood overflow channel	0–600	710
Overflow channel	0–825	1,055
By-pass channels (150% of dry-weather flow)	0–140	140
Flow tributary to plant: Main interceptor	40–210	
Flow tributary to plant: Collinwood pumps	3–20	
Bar gratings: 6-in. screens at overflows	0–790	1,100
Bar gratings: 1½-in. and ¾-in. screens	43–230	288
Grit chambers	43–230	240
Venturi meters	43–145	
Disinfection equipment (liquid chlorine)	43–230	
Submerged outlets: 84-in. concrete multiple	43–145	
Submerged outlets: 63-in. steel	0–85	

Westerly Sewage-Works

Treatment Devices	Flows in M.G.D. Operating Range	Flows in M.G.D. Maximum Capacity
Westerly intercepting sewer		859
Walworth run diversion sewer		
Inlet by-pass	0–19	
Overflow conduit	0–55	105
Open overflow channel	0–859	859
By-pass channels (150% of dry-weather flow)	0–44	
Flow tributary to plant	0–159	
Bar gratings: ¾-in. screens	0–140	
Bar gratings: 1½-in. screens		
Grit chambers and two-story settling tanks	0–96	96
	0–90	
Venturi meters	0–90	117
Disinfection equipment (liquid chlorline hypochlorite)	0–90	
	0–85	
Outfall conduit	0–90	240
Submerged multiple outlet	0–85	

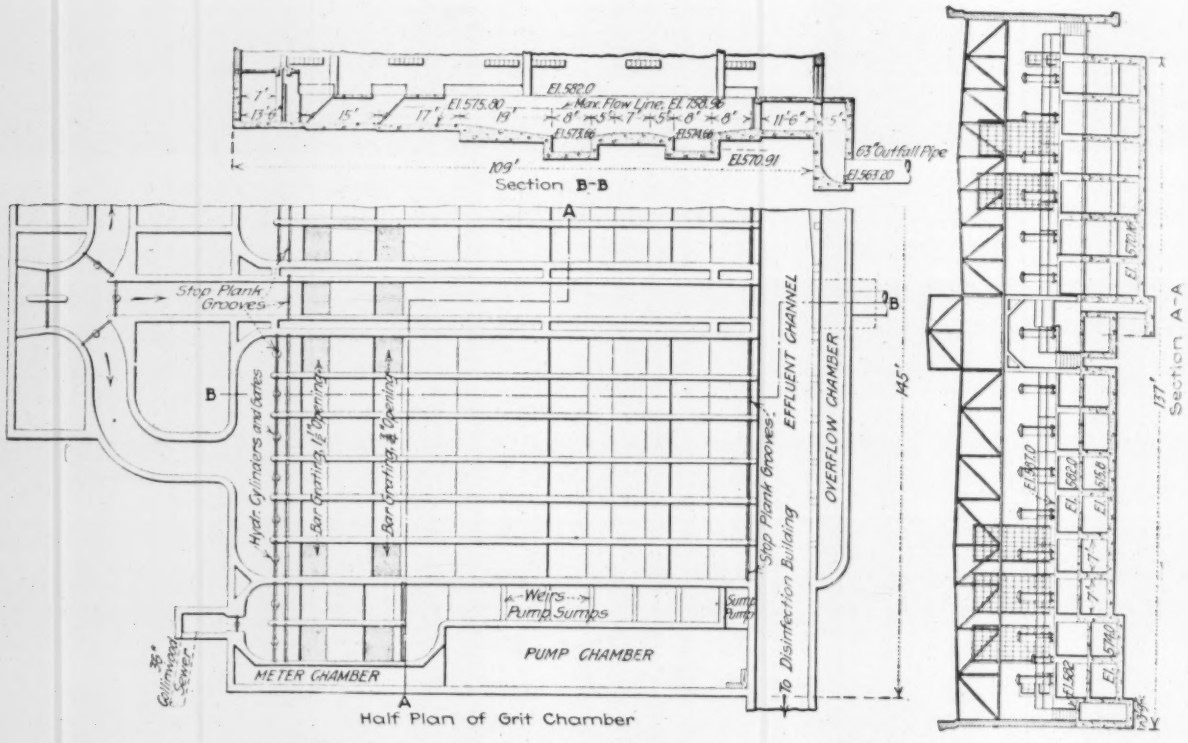


FIG. 2. PLAN AND SECTIONS OF GRIT CHAMBERS FOR EASTERLY SEWAGE-WORKS CLEVELAND, OHIO

heavy mineral matter or grit will be removed. There will follow prolonged sedimentation in two-story settling tanks, after which the sewage will pass through a venturi meter. Just beyond the meter, in a manhole, the settled sewage will be disinfected. The sewage will then pass into a submerged outfall of the multiple outlet type and be dispersed on the lake bottom in approximately 30 ft. of water about one-half mile off shore. At the Easterly plant it is proposed for the present to defer the construction of treatment devices which provide for the more complete removal of suspended matter. Table II. gives the maximum capacity of the various structures and their range of operation.

Quality of Sewage.—The City of Cleveland is sewered upon the combined plan with many overflows of the long weir type in use along the ravines and the lake front. The sewage is a typical American city sewage with the proportion of industrial wastes to domestic sewage small. Of the industrial wastes pickling liquors predominate, and at the Westerly plant these wastes become a matter of importance, especially in connection with disinfection. In 1919 the city began a special industrial waste survey with the end in view of establishing a future policy as to the discharge of these wastes into city sewers. It is desired to prevent, if possible, the objectionable conditions which these wastes cause in the sewers and at the sewage plants.

Pumping Station.—At the Easterly plant it will be necessary to pump the sewage from the Collinwood area of the Easterly district, in which it is estimated there will be about 35,000 persons in 1920. There will be three vertical centrifugal pumps driven by electric motors, operated automatically, their total capacity being 20 m.g.d. The sewage from the Collinwood area as it reaches the plant will be pumped into the flow channels just ahead of the grit chambers.

Bar Gratings.—Sewage-treatment plants can usually be built in units with additions made later as required. However, such structures as inlet sewers, flow channels, force mains and pumping station buildings, which cannot be economically enlarged to meet the increased demand, have been designed in the Cleveland plants for conditions estimated to occur considerably in the future. The inlet channels to the grit chambers are designed with velocities ranging from 3 to 2 sec.-ft. when the chambers are operating at their maximum capacity.

To provide effective rough screening it is thought that two sets of gratings, even with the same size of openings, produce better results than a single set, but their operation will involve slightly more labor. Also, a provision for two sets of gratings permits the installation of one set of finer gratings, if at any time in the future such a change seems desirable. For the present it is planned to hand-rake the gratings, but space is available for the installation of power-driven raking machinery, should it be deemed advisable. The gratings are set at an angle of 45 degrees with the vertical and are made of flat bars, bent at the top so that the screenings may be raked off without obstruction.

At the Westerly plant it is proposed to pass the sewage successively through two sets of gratings having 3-in. and 1½-in. clear openings, while at the Easterly plant the gratings will have 1½-in. and ¾-in. clear openings, respectively. It is desired at the Easterly plant to demonstrate on a large scale the practicability of disinfecting bar-screened sewage.

It is appreciated that screenings are offensive and almost as bad as sludge. For this reason, the screen chambers at each plant have been covered with buildings to increase the efficiency of their operation and to prevent the escape of odors from the sewage as it

falls through the gratings. At the Easterly plant the screenings will be shoveled into small dump cars in which they will be transported to the incinerator room while at both plants they will be pressed in large presses of the cider type and their moisture content reduced to about 65 per cent. The residue will then be burned in the especially constructed furnaces located in the screen building. The quantity of wet screenings which will be handled during the year 1925 at the Westerly and Easterly plants is estimated at 350 and 2,500 tons respectively.

Grit Chambers.—The grit chambers, which are practically identical at both plants, are to the writer's knowledge the first installations of their kind. They were designed with the intent of producing a non-odorous grit which may be used for filling-in purposes about the disposal area sites. It was found from the experimental studies that a non-odorous grit should have an organic matter content of not more than 15 per cent. As a rule, present-day grit chambers do not produce a grit with an organic matter content as low as this. In securing this kind of grit some of the finer grit may be carried past the chambers and into the two-story settling tanks. Should this occur the tank design provides for the removal of the accumulation of grit by pumping. To assist in securing the proper kind of grit, a dry-weather flow channel has been provided so that, if desirable, the grit-chamber treatment can be omitted during periods when the amount of grit carried in the sewage is practically negligible.

It will be noticed in Fig. 2 that each grit chamber has an individual set of bar gratings near its inlet end, a feature which tends to distribute the sewage flow evenly across the chamber. Further, it is expected that this type of chamber will provide uniform velocity throughout its entire length and that practically all grit will be deposited in the sumps, there then being no interruptions to the flowing sewage by uneven banks or deposits of grit on the bottoms. Grit deposited upon the sloping floors leading to the sumps will be cleansed of organic matter as it rolls along on these floors.

The number of grit-chamber units at each plant depends upon the maximum rate of dry-weather flow, together with the first flush from storms reaching the plant. The operating capacity of each unit will vary from 12 to 24 m.g.d., with working velocities of from ½ to 1 ft. per second, respectively. The over-all length of each grit chamber is 60 ft.; consequently, the maximum detention period is two minutes. Valves and drains are provided for removing the supernatant liquid without its passage through the grit, while the moisture in the grit will be collected at a sump from which it will be pumped into the outlet channel.

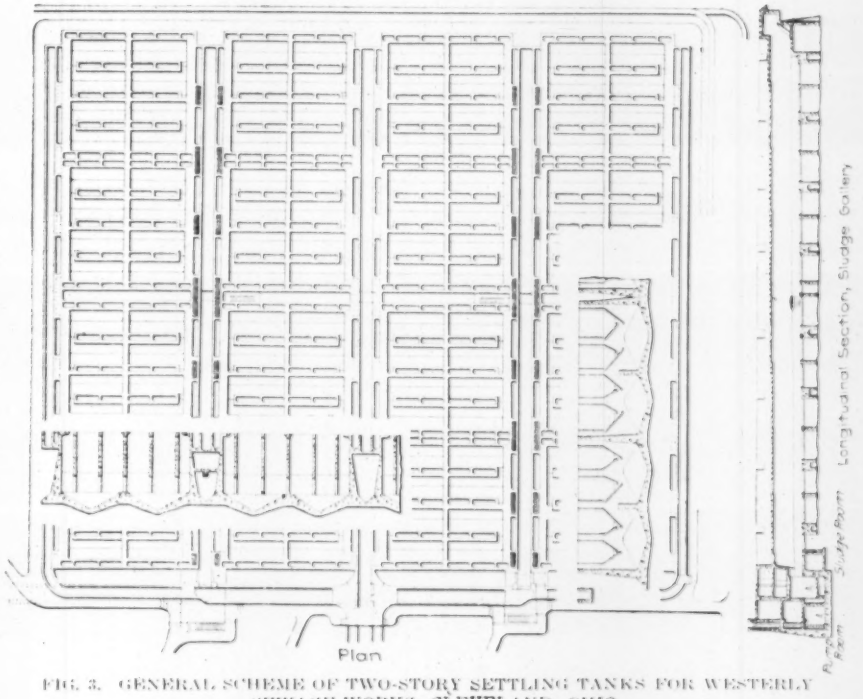


FIG. 3. GENERAL SCHEME OF TWO-STORY SETTLING TANKS FOR WESTERLY SEWAGE-WORKS, CLEVELAND, OHIO

In the grit-chamber design particular emphasis has been placed upon the importance of efficient operation. In order to place a grit chamber in operation and control the sewage flow to it, large hydraulically-operated sluice gates have been provided. While this type of gate is relatively expensive, it reduces to a mimimum the attention required of an operator to place a grit chamber in proper operation and to keep it so. Also, the sluice gates will be so installed that their operation can be controlled from a central switchboard, should this be desired in the future.

At the Easterly plant a building with ventilating equipment will permit cleaning the chambers irrespective of weather conditions, and a large number of small chambers will require a small operating crew to be engaged constantly in removing the grit. In all chambers there are provided two hoppers, thereby reducing the area over which the removal equipment must operate. The crane equipment, with clam-shell, bucket will need to operate only over the hoppers, although at this time it has not been decided definitely just what type of grit-removal equipment will be used. The capacity of the removal equipment must be sufficient to handle 8 cu. yd. of material per hour, while the deposit expected under the most adverse conditions is estimated at a rate of 2 cu. yd. per million gallons of sewage flow.

Flow Channels.—At the Westerly plant the sewage as it leaves the grit chambers will pass into an equalizing chamber by means of which the sewage flow will be divided. This chamber has inside partition walls through which are openings for equalizing the head upon the individual flow channels leading to gates which control the direction of flow. Stop-plank gates will be used for the present, but provision is made for the installation of mechanically operated gates, if desirable in the future. The sewage will then pass into open distributing channels and, prior to its entering a tank,

will flow into a small entrance chamber. There its velocity will be reduced considerably since its exit is through an orifice at the bottom of the chamber and about 3 ft. below the water surface in the tank. It is expected to collect in this trap a considerable quantity of the greasy and soapy substances which form as films upon the water surface in settling tanks. In order to control accurately the sewage flow to any tank and, further, to be able to determine promptly the amount of flow, adjustable weirs have been installed in the inlet openings to the entrance or trap chamber. By changing the stop-plank gates the direction of flow in the distributing channels is reversed, thereby reversing the flow in the settling tanks; the entrance chambers being the same at either end of a tank.

Settling Tanks.—At the Westerly site there will be 32 two-story settling tanks (Fig. 3) 50 feet in length, 25 feet in width and with two hoppers in each. The water depth in the tanks will be about 27 ft. and a free-board of 2 ft. is provided. The tanks are designed to give a detention period of 100 minutes, which means that this period will be about 2½ hours when the plant is first placed in operation. The width of the slot has been made 8 in. in the clear and the slope of the flow partition floors 1.5 on 1. The flow partition walls and floors are 3 in. thick below the water line, and are to be constructed by using the cement gun.

A scum capacity of 0.6 cu. ft., and a sludge capacity of 1.2 cu. ft. have been provided for each person. The sludge storage period amounts to 5.7 months but this period will be increased to about 8.5 months during the first year of operation.

Sludge will be withdrawn from the tanks through 8-in. pipes operating under 7½ ft. head, one independent vertical riser in each hopper discharging into the main which leads to the sludge gallery between the tanks. The sludge will discharge from the main into an open channel located below the floor in the center of the sludge gallery. There are two sludge galleries, the channel in each leading to a sludge well which has a storage capacity of about 500 cu. ft. Here a vertical centrifugal pump and an ejector will be provided for delivering the sludge from the sump to either sludge-drying beds or to barges. Each pumping device is capable of handling all the sludge. A special drain pipe located beneath the sludge gallery floor is connected to the inlet end of the pumps for the purpose of removing any fine silt which may deposit in the hoppers and cannot be removed hydraulically.

In order to minimize odor difficulties all gas vents will have wooden covers of the hinged type and, should it be found necessary, the tanks have been so designed that a building may be placed over them.

Measuring and Disinfecting Sewage.—At each plant the sewage will pass through a large venturi meter with the necessary recording equipment for measuring the sewage flow and connections for automatically controlling the quantity of disinfectant which is to be added. It is proposed to install standard-size liquid chlorine machines of the solution-feed type and to disinfect the sewage at a manhole just beyond the venturi tube. Since very large quantities of chlorine will be used, it will probably be supplied to the sewage through injectors, such as have been used by the New York Department of Water Supply at Kensico. The injectors mix the chlorine with water, yet the control apparatus is of the direct-feed type, since the absorption chambers and water connections at the control panel are omitted. Table II. shows the capacity of the disinfecting equipment.

Submerged Outfall.—There are now in operation at the two sewage-works three submerged outfalls; two at the Easterly plant, one being new, and a new outfall at the Westerly site. The old outfall pipe at the Easterly plant is of steel, 63 in. in diameter, and has its end turned up in about 30 ft. of water approximately one-half mile off shore. The capacity of this outfall is estimated at 85 m.g.d. when operating under 6.5 ft. of static head.

The outfall at the Westerly plant is of concrete and steel, while at the Easterly plant the new outfall is of reinforced concrete throughout. In each case the sewage is discharged in about 30 ft. of water at least one-half mile off shore, through openings in a 1,000-ft. tapered section. Along the tapered section are about 140 holes, 7½ in. in diameter 6½ ft. c. to c., staggered in two rows each 45 degrees off the vertical axis. The capacity of the Easterly outfall is estimated at 145 m.g.d. when operating under 5 ft. of static head, while the capacity of the Westerly outfall is estimated at 85 m.g.d. when operating under 11 ft. of static head.

Sludge Disposal.—During the earlier years of operation it is proposed to remove small quantities of thoroughly digested sludge from the two-story tanks at the Westerly plant from time to time, the winter season excepted, and load it into barges. These barges will then be towed out into the lake about three miles and discharged on the Government dumping ground where the yearly dredgings from the Cuyahoga River are deposited. It is expected that this small quantity of well digested and innocuous sludge will at once become thoroughly dissipated in the lake water and will prove to be entirely unobjectionable. Nevertheless, the city has acquired sufficient land at that site to provide for the draining and drying on sand beds of all the sludge from this plant in the event that disposal in the lake should eventually become undesirable. The sludge beds when built will be enclosed by suitable buildings, presumably of a type similar to those used for greenhouses, thus protecting the sludge from rains, facilitating drying, and preventing the escape of odors, should any arise. The area of covered sludge-drying beds required is based on the assumption that 5.3 persons will be cared for on each square foot. The quantity of sludge produced by each person every day was estimated at 0.007 cu. ft., which means that about 27,500 cu. yd. of wet sludge (moisture content 88 per cent) must be removed by the barges each year. Upon this basis a barge with a capacity of 300 cu. yd. must be towed to the dumping ground once every two days during the summer season of the year when the maximum rate of disposal occurs.

General.—A laboratory and office building have been provided at each treatment plant, and a separate building for housing the disinfection equipment and storing supplies used in connection therewith. At the Westerly plant an additional building is provided for housing the locomotive which hauls the dump cars used in the disposal of grit, and for a repair shop and garage. All buildings are harmonious in architectural appearance, are of substantial construction, and are designed for a minimum maintenance expense. The grounds surrounding the plants will be parked and the general appearance made as attractive as possible. The ventila-

tion of the buildings will be taken care of by tall chimneys, a feature made necessary by the locations of the plants and their lack of isolation.

The construction of both plants should proceed rapidly during the year and it is expected that they will be ready for operation by the first of next year. Robert Hoffman is chief engineer and commissioner of the Division of Engineering and Construction, of which the Sub-division of Sewage Disposal is a part. The work of design and construction herein described is under the supervision of the writer. J. M. Heffelfinger and A. A. Burger are the resident engineers in immediate charge of the construction, and the Masters & Mullen Co. and the American Construction Co., both of Cleveland, are the contractors for the Westerly and Easterly plants respectively.

New Contract Drafted To Cover Detroit Sewer Work

IN ORDER to induce contractors to bid upon portions of Detroit's $50,000,000 sewer construction program a special commission, appointed late in 1919 by the Common Council of Detroit, has incorporated in its report recently submitted a contract form containing clauses which materially minimize the risk incident to bidding with materials and labor at present uncertain levels. The new contract form, prepared after several months' investigation of local conditions and after various conferences between the commission and city officials, was recently adopted as the form of contract to apply to future sewer contracts in Detroit by the Common Council sitting as a committee of the whole. Its early acceptance by the Common Council is predicted.

Salient changes in the new contract form include a sliding scale for compensating contractors who are forced to expend considerably more for labor and materials than prices upon which they base their bids. The contractor is safeguarded through a clause which states that the city will stand 75 per cent of the additional cost of labor and certain materials above prices specified in the contract. Such prices of materials and wages for labor will be the prevailing rates at the time the contract begins of execution. This so-called sliding scale compensation becomes inoperative after the expiration of the contract time limit.

In the event that increased compensation is sought by the contractor owing to higher wages being paid than the schedule named in the contract the contractor must present to the Commissioner of Public Works individual time slips and daily records indicating the excess wages paid. Any failure to submit such evidence, or a failure to notify 48 hours in advance that a wage increase is to be paid, will act as a waiver upon the right of the contractor to receive any additional compensation.

Another new feature of the contract pertains to the inclusion in monthly estimates of a certain amount of materials. In the event it is found necessary to store on the job large quantities of materials in order to prosecute construction these materials up to 80 per cent may be included in the monthly estimate. What allowance will be made the contractor in such a case rests with the Commissioner of Public Works.

While the special sewer commission found it necessary to make some provision in the new contract to safeguard the contractor against rising material and labor prices, it was deemed inadvisable to include any clause which should allow the city to benefit directly from any decrease of cost of labor and materials. Reasons for omitting such a clause were enumerated as follows: (1) Because the prices named in the contract do not establish the exact prices and rates that the contractor must pay; (2) if possible a contractor will pay less than the established rates for materials and labor; (3) if lower costs are assured the contractor they will be reflected in his bid; (4) so far as there is any possibility of such an asurance to the contractor the advantage will accrue to the city.

Several conferences were held in which not only public officials participated but contractors already engaged upon sewer construction for the city of Detroit. Various alleged defects in existing contracts were pointed out by these contractors and the new contract form submitted by the commission include minor improvements over the old established lump sum form. For instance, certain contractors complained of not receiving their partial payments in time to take advantage of cash discounts when purchasing minor materials and accessories. The new contract, therefore, specifies a date not later than which monthly estimates shall be paid, thereby allowing the contractor to take advantage of cash discounts. Then again, any compensations due the contractor from his payment of excess labor and material prices are to be included in monthly estimates, and the 10 per cent retention is not to apply.

Details Clarified

Various details which in the past have led to litigation are clarified in the Detroit contract. It is specifically stated that in encountering subsurface, surface and overhead structures the contractor is to secure them in the interests of public safety at his own expense, in case they are not to be moved. When subsurface, surface, or overhead structures require to be moved they must be moved not at the contractor's expense. When subsurface structures not shown on plans are encountered the contractor is entitled to reimbursement, and delays due to encountering structures necessitating changes in alignment or grade will not be counted within the time limit.

Before adopting the above outlined form of contract the special sewer commission considered several forms, including a cost-plus-percentage and the cost-plus-a-fixed fee contract. Owing to the fact that a cost-plus-a-percentage type precludes competitive bidding, which the city charter insists upon in municipal work, that type was little thought of. In a cost-plus-fixed-fee contract the lowest bidder is selected by comparing the estimated field costs plus a fixed fee. As such a selection does not guarantee that the lowest bidder will do the work at the lowest total cost to the city, coupled with the fact that that form of contract would not be adapted to city work of such magnitude because of the large organization needed to keep complete cost records, the cost-plus-a-fixed-fee type was also discarded.

The special sewer commission, which prepared the contract above outlined, is composed of Wilson S. Kinnear, consulting engineer, New York City, chairman; William C. Hoad, professor of sanitary engineering, University of Michigan; Edward D. Rich, state sanitary engineer, Michigan; John A. Mercier, contractor, Detroit, and George R. Cooke, contracting engineer De-

troit. The commission was first appointed as a consultant, being given by the Common Council authority to perfect its own organization, and its entire freedom of action as to the scope of its work. At the first meeting of the commission in January, 1920, the city engineer of Detroit gave an historical review of the study and development of the proposed sewerage system and explained to the commission difficulties connected with contract work in the city of Detroit. It was disclosed that the progress of sewer construction work for the year 1919 had been disappointing. The city engineer explained that it would be necessary to complete about $1,000,000 worth of work monthly to carry out satisfactorily his sewer construction program, whereas the maximum month's work during 1919 amounted to approximately one-quarter of that amount.

Trainshed Roof of Steel Arches Instead of Columns

Spacious Appearance Given to Indianapolis Union Station by Novel Design—Monitors for Light and Ventilation

WITH the purpose of obtaining a low-roof trainshed having an exceptionally well-lighted and attractive appearance the steel trainshed of the new union station at Indianapolis, Ind., was designed with arches instead of columns to support the roof framing, and with monitors extending above the level of the main roof. As the arches rise to the top of the monitor framing the interior effect of height is increased materially. This distinctive and unusual construction was adopted as an element of architectural design, it being considered that a more lofty effect and a more decided appearance of spaciousness would be given to the trainshed by the rows of tall arches than by the usual arrangement of relatively short columns in trainsheds of the low-roof type, and that the light and ventilation would be improved materially by the high monitors. This roof is 930 ft. long and 238½ ft. wide, covering six platforms. A portion of the completed framing is shown in Fig. 1.

The monitors are located over the platforms, at the low points of the main roof, above which they extend to a height of about 7½ ft., as indicated in Fig. 2. Being open at the bottom they give an actually increased height over the platforms, where ordinarily the roof is at its lowest level. The purpose of this arrangement is to provide ample light and ventilation at the platforms, the side of each monitor being covered mainly with wire glass and leaving a continuous open ventilating space at the top. This opening is covered by a narrow umbrella roof of red tile, carried by light steel framing, as shown. Details of the main and monitor roof framing are given in Fig. 3.

Amber-co'ored ribbed wire-glass is used for the monitor skylights, the effect of this glass being to deflect or absorb the heat rays of the sun. Recent experiments are stated to have shown that this glass will keep the interior temperature lower by 2 to 6 deg. F. than when ordinary clear glass is used. As a precaution against breakage of glass by movement of the roof due to vibration and temperature changes the panes will not be set tight in the frames but will be sufficiently loose to permit considerable movement in the steelwork without breaking the glass.

Another modification is introduced in the design of the longitudinal smoke ducts or roof openings which extend over the center lines of the tracks, Fig. 3. The slabs which form the sides of these ducts are inclined inward at the top instead of being vertical for their full height, the narrower top opening giving less opportunity for snow and rain to drift upon the platform. At the same time the width is sufficient for free passage of smoke and steam without any tendency to choke the exhaust of the engines. In this case the slabs are 63½ in. deep, and the space between them is 36½ in. wide, at the bottom and 19½ in. at the top. A 3-in. concrete slab covers the sections of the main roof between the monitors, and the monitor side between the skylights. Inside the monitor the roof framing is open. A waterproof roofing is laid over the concrete.

In the crutches formed at the haunches of the longitudinal arches are seated transverse curved girders

FIG. 1. LONGITUDINAL STEEL ARCHES CARRY ROOF OF INDIANAPOLIS TRAINSHED

upon which rest the inclined beams of the monitors. Between the transverse girders there are two intermediate transverse beams or rafters suspended from a longitudinal girder resting on the crowns of the arches. Each of these rafters is a rib of I-section, with inclined ends forming beams for the monitors and a curved middle portion spanning the tracks. Light rafters over the platforms are attached to the corners of these rafters, as shown. This arrangement makes a four-point connection between the main rafter, platform rafter, monitor beam and longitudinal strut. Four lines of trussed purlins are framed between the rafters in each bay, these purlins being embedded in the concrete slabs which form the sides of the open smoke ducts already described.

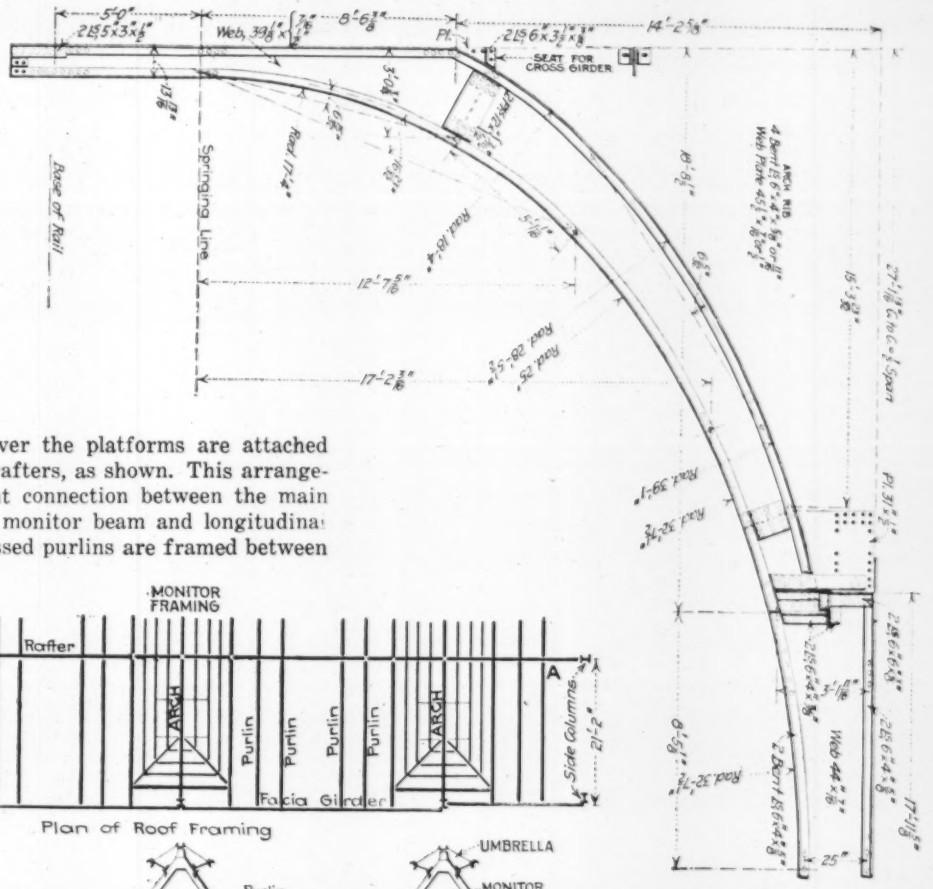


FIG. 4. ARCH RIB SUPPORTS ROOF

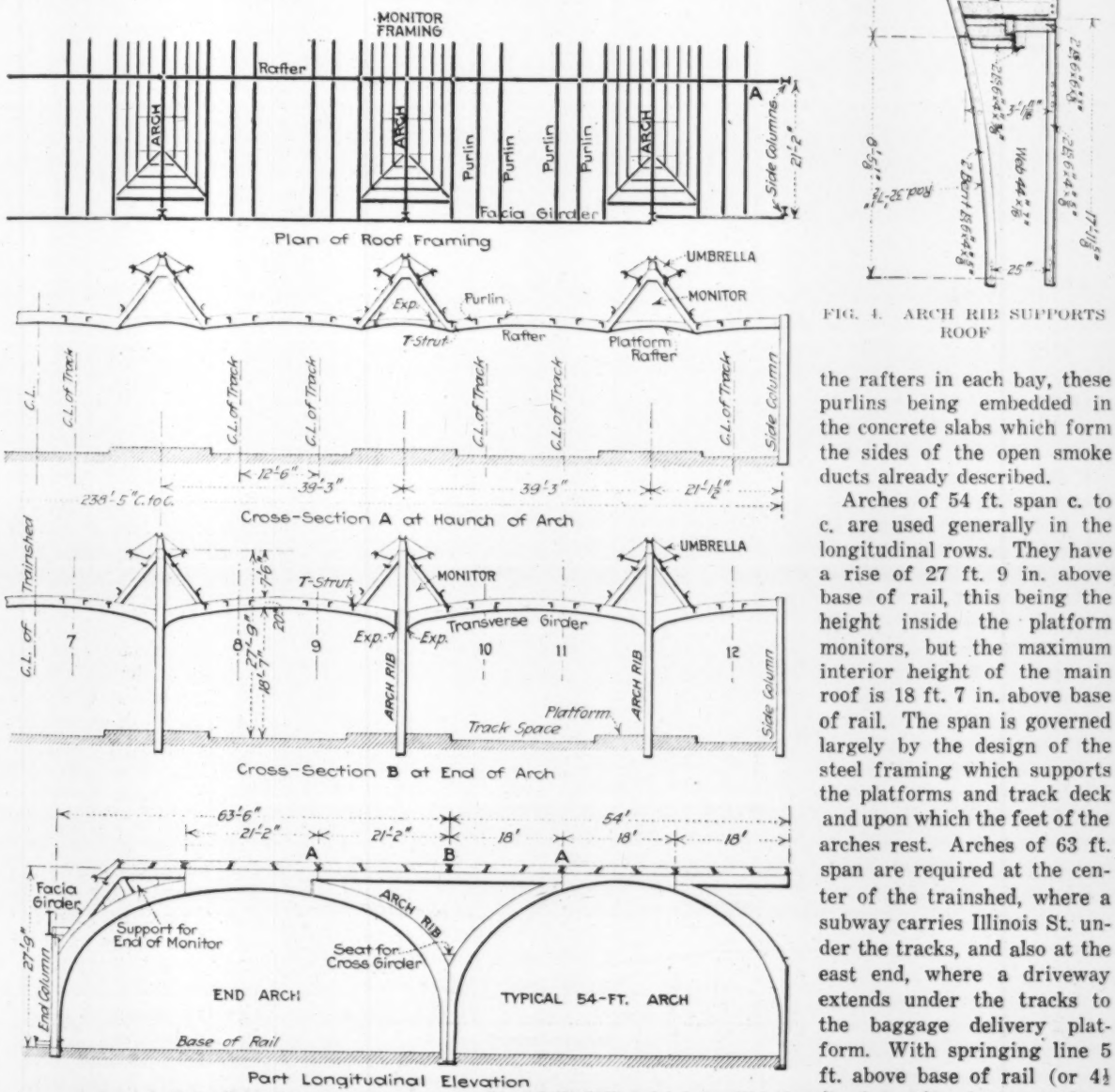


FIG. 2. ARCH SUPPORTS AND ROOF FRAMING

Arches of 54 ft. span c. to c. are used generally in the longitudinal rows. They have a rise of 27 ft. 9 in. above base of rail, this being the height inside the platform monitors, but the maximum interior height of the main roof is 18 ft. 7 in. above base of rail. The span is governed largely by the design of the steel framing which supports the platforms and track deck and upon which the feet of the arches rest. Arches of 63 ft. span are required at the center of the trainshed, where a subway carries Illinois St. under the tracks, and also at the east end, where a driveway extends under the tracks to the baggage delivery platform. With springing line 5 ft. above base of rail (or 4½ ft. above the platform) there

is ample headroom at the ends of the arches. As baggage is handled below the track deck there is little trucking on the platforms to take into consideration.

Each arch is a plate-girder rib, built in three sections for erection, as shown by Figs. 2 and 4. At the crown the extrados is flattened to carry the 18½-in. plate girder forming the crest of the monitor roof framing. The monitor roof beams and the main and intermediate rafters are built-up members of I-section, while the platform rafters are of T-section. No diagonal bracing is required as the concrete slab ties the framing together effectively. At each end of the trainshed the last arch is framed against a column supporting a transverse fascia girder from which are suspended curved angles carrying the end of the concrete slab and the portal arches over the tracks. Roof drainage is carried off by drain pipes laid along the rafters and down the ends of the arches to pass through the platforms. This roof was designed for a live load or snow load of 40 lb. per sq. ft.

For the main part of the erection a traveling stiff-leg derrick was used, moving on rollers and having a steel box-latticed boom 95 ft. long, as shown in Fig. 5. The

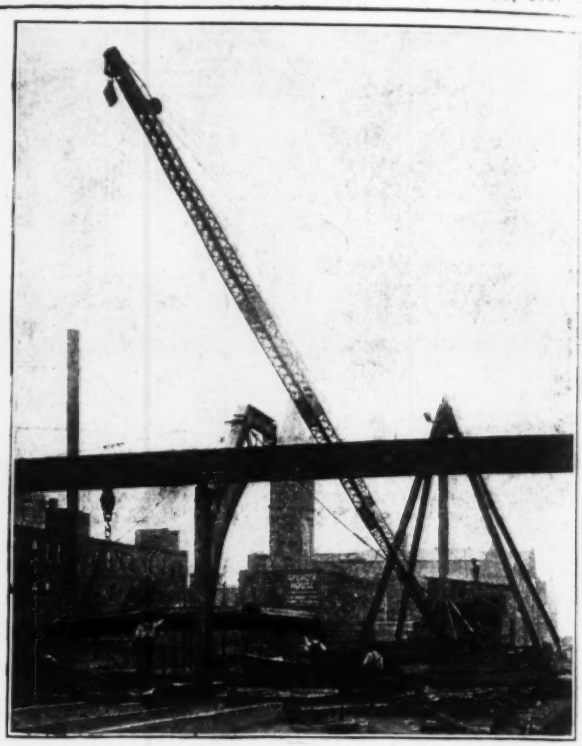


FIG. 5. DERRICK ERECTING TRAINSHED ROOF

heaviest parts handled weigh 10.8 tons each. Traffic did not interfere with the erection, as this was done from the new elevated track-level while traffic was being operated on the old tracks at the street level.

The roof design, with its arch supports and monitors, was worked out by Price & McLanahan, Philadelphia, architects for the station, under the supervision of T. R. Ratcliff, engineer of maintenance of way, Indianapolis Union R.R. Mr. Ratcliff also superintended the erection of the trainshed and the construction of the track-elevation work on which the new trainshed has been built. Contracts were let to the Mount Vernon Bridge Co., Mount Vernon, Ohio, for the steelwork of the roof, and to the Powers & Addy Co., Inc., Indianapolis, for the erection. The completion of the trainshed is one of the last steps in the construction of the new Union Station with elevated tracks, as described in *Engineering News-Record*, July 10 and Aug. 7, 1919, pages 84 and 265.

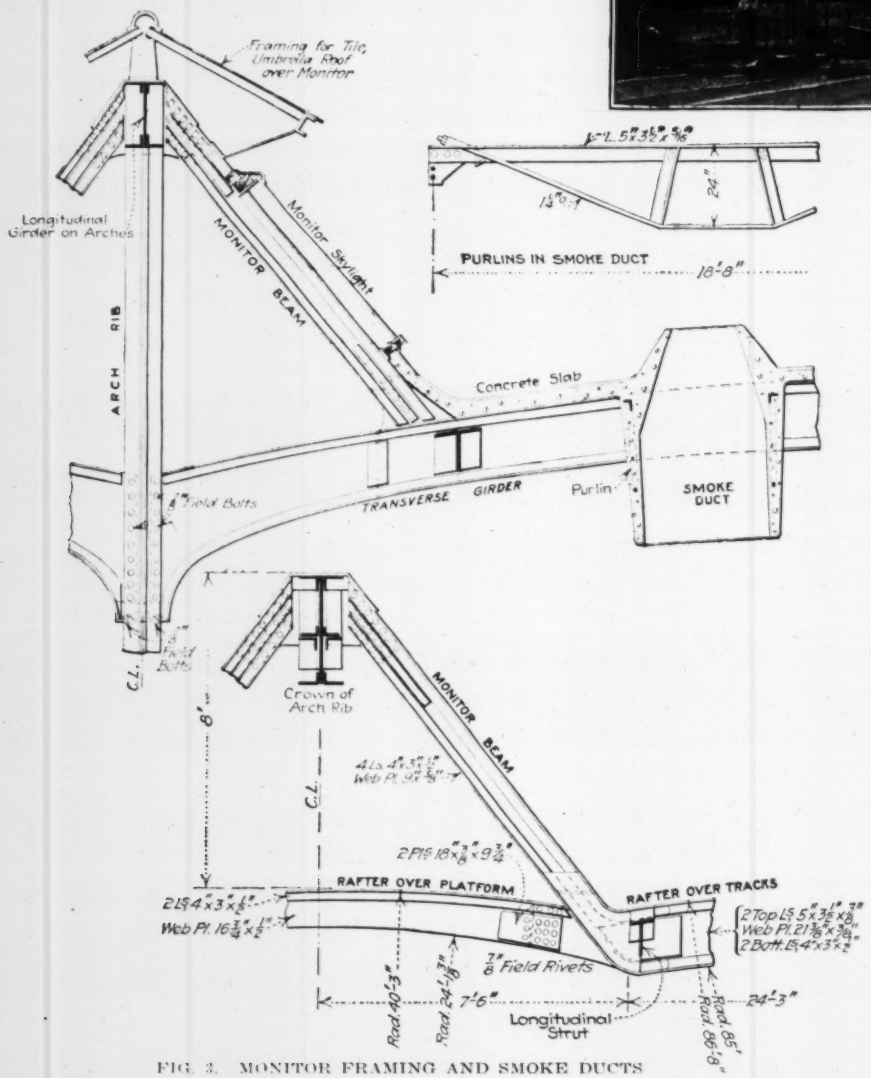


FIG. 3. MONITOR FRAMING AND SMOKE DUCTS

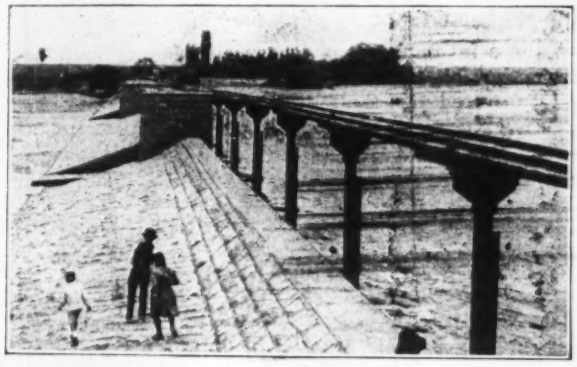
Irrigation in Mendoza, Argentina

Melting Snow from Andes Furnishes Ample Water Supply — Engineer Opportunity Contingent Upon American Financing

By S. T. Henry
Vice-President, Allied Machinery Co. of America, and Formerly Associate Editor of *Engineering Record*

More than 100,000 acres of land are under intensive irrigation and cultivation in a single project in the immediate vicinity of the city of Mendoza, Argentina. This is only one of a number of large irrigation projects in the semi-arid sections of that country. Some of these projects have been under irrigation for many years; others are of more recent development. Additional works are being built, and many new projects are contemplated. There is apparently ample water to serve great new areas of fertile land on which the rainfall is insufficient.

Favorable topography, soil and climatic conditions combine to render irrigation most profitable in the provinces of the Argentine close to the eastern slopes of the Andes Mountains. In fact, the products raised vary from sugar cane, in the Tucuman district in the



RIO BLANCO MASONRY DIVERTING DAM

north, to wheat and other colder country products in the south. Irrigation, therefore, should have a great future in the Argentine.

The irrigated section in the vicinity of Mendoza lies at the foot of the Andes Mountains. It is in about the same latitude as Los Angeles, Cal., and the climates of the two places are very similar. The mountains directly to the west rise to heights of from 12,000 to 19,000 ft. above the sea. Many peaks in the vicinity are covered with perpetual snow. The snowfall is heavy in the winter down to elevations as low as 8,000 ft. The water used for irrigation in this and most other Argentine projects comes from this source.

Irrigation is known to have been practiced in Mendoza and vicinity for more than 800 years. Authentic records show that the Eighth Inca of Peru sent an irrigation engineer to Mendoza to assist the natives resident there then in laying out and constructing their works. When the Spaniards arrived about 1550 they found extensive irrigation works on which they made comparatively little improvement. These conditions continued until the existing works were built in the late 80's and early 90's of the last century.

Water for irrigation in the vicinity of Mendoza is diverted from the Rio Blanco a few miles above the city. This stream has a relatively large minimum flow. When the snow in the mountains is melting the river carries tremendous volumes of water. At rare intervals cloudbursts in the watershed also cause freshets.

CANAL INTAKE AT END OF DAM

Geologists consider that the land around Mendoza was formed by wash from the high mountains to the west. The Rio Blanco in the vicinity of the intake runs through this alluvial deposit. The bed of the stream is of great width in most places, and consists of boulders and coarse gravel containing very little sand. On account of the steep gradient of the stream and the great volumes of water carried by it when in flood, the channel shifts frequently. Indications are that the entire stream formerly changed its course from place to place over a wide area.

The water is diverted from the Rio Blanco by a low dam of stone masonry, which was finished in 1889. Details of the construction of this dam were not available at the time these notes were made. One of the accompanying photographs shows a view of the dam taken from the intake of a canal at one end.

According to local engineers there is no bed rock at the site. A foundation was secured simply by removing the boulders and coarse gravel and replacing them by large boulders carefully placed and grouted in position. The fact that the dam has stood all these years in such a violent stream is probably attributable to several simple fundamental conditions.

In the first place, the structure is low. The total net head against it is evidently always small.

A second favorable factor is the relatively great width of the dam section as compared with the height. This can be seen from the photograph. This view also shows the broad apron which reduces tendency to scour at the toe.

The stream carries great quantities of sand and gravel when in flood. This detrius is deposited behind the dam so as further to reduce the tendency to undercut the structure.

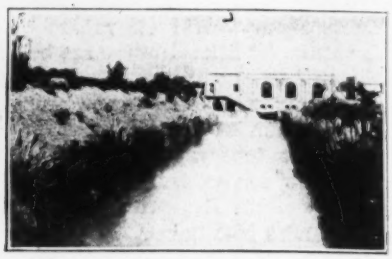
A canal leads from an intake at each end of the dam. One of these intakes is shown in an accompanying photo-

graph. Both intakes are built integral with the adjacent end of the dam. In the dam are five groups of gates through which the sand and gravel that accumulate back of the dam are flushed through the latter. The distribution and arrangement of these gates are such that they can be manipulated so that comparatively little sand and gravel gets into the canals. The deposits back of the dam also can be flushed through the gates without resort to excavators or to hand labor.

Prevention of scour at the ends of the dam also has contributed to its stability on an apparently uncertain foundation. The tendency of the stream to shift its channel, and at times its entire course, was recognized from the beginning. Well-protected levees were built along the course of the stream above the dam. These were planted closely with Lombardy poplars. The area back of the levees to a width of several hundred yards also was planted with a dense setting of these trees, which have grown to good size. The closely matted roots of these thick clumps of artificial woods evidently have served their purpose well.

UNLINED CANAL WITH POPLARS ON BANK TO PREVENT EROSION

SECTION OF LINED CANAL DIRECTLY ABOVE POWER HOUSE



POWER HOUSE FROM DOWNSTREAM SIDE

The main canal leading from the left-hand end of the dam, looking downstream, serves a greater area than the one on the opposite side. This canal and its main branches are more than 75 miles long. One of the photographs gives an idea of the size of this canal and the volume of water carried by it. This picture also shows how Lombardy poplars and other planted vegetation is used to prevent bank erosion by the relatively high velocity in the canal.

About a mile from the intake of the left bank canal advantage has been taken of the topography to develop hydro-electric power in a low head plant. One of the photographs shows the section of concrete-lined canal directly above the power house. Another picture shows the power house from the downstream side.

No outstanding features are evident in the construction of the main and secondary laterals. The gate structures are either of brick or concrete, with steel gates of modern design. None of the laterals or ditches is lined.

Some of the main laterals and practically all the secondary laterals are built along the sides of the highways which network the irrigated district. This arrangement permits the ditches to be maintained by the forces which keep up the roads. It also provides water for sprinkling the latter, which are mainly surfaced with gravel.

The roads are divided into sections for maintenance. Each section is assigned to one man. The length of the sections varies according to the amount of work required to maintain the road surface and the irrigation ditches along both sides of the latter. One of the photographs shows a road-section man and the results of his work on the irrigating ditch. Another shows one of these men drawing water from the irrigation ditch with a bucket to wet down the road surface. The numbered targets shown in these two pictures are placed by the men near the point where they are at work in order to facilitate the location of them by inspectors, and for several other reasons.

Most of the land under irrigation is devoted to growing grapes. Wine is made from the bulk of the grapes, although some grapes are grown for table use. The land appears to the eye to be almost absolutely level, but there is ample slope to permit of very satisfactory irrigation of the vineyards. The latter are owned and cultivated largely by Argentines of Italian and French extraction. Their methods of culture are as advanced as may be found anywhere. Wines made in this section are shipped all over the world. The great wealth and the high state of development of the district are good evidences of the permanent success of irrigation as it is practiced here.

Local landowners seem to be convinced that there is little opportunity to increase the area under irrigation in the vicinity of Mendoza. Well-informed local engineers differ with this viewpoint. It is true that there is a shortage of water during a part of some seasons. There also is no opportunity to build impounding reservoirs on the watershed above the intakes, but everywhere there is evidence that the duty of the available water could be greatly increased. The situation is similar to that which exists on several irrigation projects in the United States.

Lack of lining in the canals, laterals and ditches through dry, porous soil must result in very large losses. Since there is practically no frost in this locality, and the banks of cuts stand well, very thin linings should be sufficient. Even though the cost of lining might be high, the additional land which could be brought under cultivation would certainly justify the necessary investment. Good vineyards sell locally at from $1,500 to $2,500 per acre. They evidently produce good rates of return at these valuations.

Another opportunity to increase the duty of the available water is through better methods of application to the land. Too much water is said generally to be used. This difficulty presents more than a physical problem. It has been solved in very few places in the United States. There apparently are few projects where the water users are under sufficient control to permit much progress in this direction.

American irrigation engineers would find much of

IRRIGATION DITCH ALONG ROAD SPRINKLED BY HAND

interest in the design and operation of the works of the projects in the vicinity of Mendoza. Other projects in the Argentine also offer valuable ideas. Whether there is an opportunity for American engineers in future irrigation works in the Argentine depends largely on how such works are financed. If money is furnished by American capitalists then American engineers may be employed in the more important positions. In case the financing is done elsewhere American engineers are likely to secure only secondary positions. Engineers thoroughly experienced in irrigation work would do well, however, to study closely the possibilities for them in the Argentine. This can be done properly only by a visit to the country, and for such a trip a knowledge of the language is very desirable.

Floods Wash Out Part of Apron of Granite Reef Dam

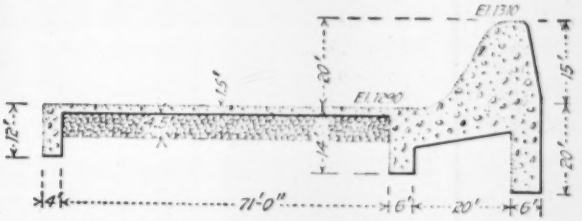
Damage Downstream Pavement of Porous Foundation Diversion Dam on Salt River Project of Reclamation Service

UNUSUAL flood conditions on the Salt River project of the U. S. Reclamation Service during the last part of 1919 resulted in some damage to the downstream apron of the Granite Reef diversion dam, which is of interest because it is the second time that this structure has been in similar trouble. Furthermore, a somewhat similar dam in another location on the project was damaged in like manner in an earlier flood.

The Granite Reef diversion dam is located about 45 miles below the Roosevelt dam and forms the main storage for the Salt River project. The diversion dam is built at a point where bedrock is so deep as to make it impracticable to extend foundations to it. A section is shown in the accompanying drawing. As given there, it has three curtain walls, one at the upstream and one at the downstream side of the main dam section, and one at the downstream end of the downstream apron; the two upstream walls are 6 ft. in thickness and the downstream one 4 ft. The one under the upper toe is carried down to a depth of about 18 ft. below the elevation of the apron below the dam, and under the lower toe is carried to a depth of 14 ft. below the surface of the apron. Through the lower toe wall there were left openings 6 in. square, 5 ft. apart, and about 6 ft. above the bottom of the wall. These openings permit the water that would collect under the dam to drain out under the apron.

The apron itself was made on a foundation of placed boulders having a thickness of 4½ ft. The thickness of the apron itself is 1½ ft. and it is laid in squares of about 10 ft. on a side, with a space of about 3 in. between the squares.

During 1919 there was a long wet period in the whole Salt River district. This started with unusual rainfall on the watershed during the last half of July and the



MIDRIVER SECTION OF GRANITE REEF DIVERSION DAM

first half of August, causing a gain in the reservoir within a period of twenty days of over 230,000 acre-ft., which exceeds any former summer gain six times. Little or no damage to the works of the project, however, resulted from this flood. A second floor occurred in November, 1919, reaching its peak at the Granite Reef dam on Nov. 27. The average depth overflowing the entire length of the 1,000-ft. dam was 7.65 ft., equivalent to approximately 100,000 sec.ft. The result of this flood was the loss of the protective apron of the diversion dam 75 ft. wide by 540 ft. long, and a portion of the concrete cut-off wall located 75 ft. downstream from the toe wall of the dam. A former flood in 1916 partly washed away this apron and it had been replaced on the gravel backfill in the form of slabs about 10 ft. square and 14 to 16 in. thick, tied together with steel cable and other reinforcing material.

When the flood went down it was found that repairs would have to be made including replacing the damaged cut-off wall and the construction of a strip of the apron 75 x 540 ft. with an average thickness of 6 ft. including the boulder bottom. Repairing was started Dec. 19, 1919, and completed Feb. 7, 1920. It required 7,666 cu.yd. of concrete at a cost of about $11.26 per cu.yd.

Another flood took place culminating on Feb. 17-23, 1920. This flood topped the Granite Reef dam with a maximum overflow of 8 ft. carrying approximately 107,000 sec.ft. of water. The repairs to the apron, however, had been completed and the dam withstood the second flood with no damage.

A somewhat similar dam on the Salt River above Roosevelt dam was described in *Engineering News*, May 25, 1916, p. 974. A large part of this dam was washed out by a flood in January of that year.

The present damage to the Granite Reef dam is described in the *Reclamation Record*, July, 1920, by W. R. Elliott, formerly general superintendent and chief engineer of the Salt River project. This project has been operated by the water users themselves since Nov. 1, 1917.

Terre Haute May Have City Manager

The city-manager form of government is under consideration at Terre Haute, Ind. The local chapter of the American Association of Engineers has been asked to co-operate in the movement and has referred the request to its Civics Committee.

Wet Haulage to Road Excels Dry Haulage to Mixer

Comparison of Two Methods Determine Adoption of Central Mixing Plant and Wet Batch Haulage on New Contracts

WITH light motor trucks carrying one-batch loads, over 30 per cent greater yardage has been obtained on a 13½-mi. concrete road job in Illinois when the wet batch is hauled to the road, than when the dry batch is hauled to the mixer. Oversize pneumatic tires on the trucks and a truck turntable have reduced cutting of the subgrade to unimportant proportions. A fleet of twenty-six trucks hauling an average distance of 2½ mi., has served two mixers whose average rates of output have been 560 ft. and 420 ft., of 16- and 18-ft. pavement per day.

In planning the work, the road, which is a portion

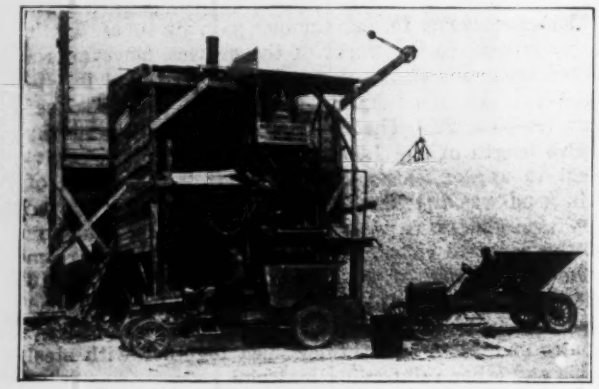


FIG. 1. CENTRAL UNLOADING AND MIXING PLANT

of the National Trails Highway in Fayette County, was divided into a section 5.27 mi. long to be constructed by dry batch haulage to a paving mixer and a section 8.2 mi. long to be constructed by wet batch haulage to the road. Construction proceeded on both sections at once, the 26 trucks being divided between the two according to the relative lengths of haul. A separate statement of the outfit and operations for each section simplifies comparison.

Wet Batch Method.—The location of the central mixing plant was at about the middle of the 8.2-mi. section. Fig. 1 is a view of the installation. It is to be noted particularly that the mixer is a two-bag batch machine. The materials were unloaded from cars by a derrick operating a clamshell bucket and whenever materials were received in such quantities as permitted them to be placed in reserve storage, this was done. Otherwise the materials were unloaded from the cars directly into the storage bins, which had a capacity of about three carloads. From the bins the materials were measured directly into the mixer hopper. With direct discharge of the mixed batch into the truck, the aggregates therefore did not touch the ground from the cars or stockpile to the pavement slab. Fig. 2 shows the wet batch being dumped ahead of the finishing machine.

Eleven men were required for the wet batch method: Two men feeding cement to the mixer; one man on the rock and sand bins; one mixer engineer; one mixer

FIG. 2. WET BATCH DISCHARGED AT FINISHER

fireman, one man discharging the mixer; two men spreading concrete; one man dumping the trucks; one man operating the finishing machine and one man assisting in finishing the slab.

Dry Batch Method.—On the section constructed by dry batch haulage the unloading and proportioning plant was located at one end. The materials were unloaded and stored in the same manner as at the central mixing plant. The bins were arranged, however, so that the trucks drove under them and received their loads through bottom doors. A truck was loaded in 15 sec.

The operating crew consisted of sixteen men as follows: Four men dumping cement into the trucks; two men on the rock and sand bins; one man dumping trucks into the mixer skip (Fig. 3); two men keeping the subgrade in shape around the mixer; one mixer operator; one mixer fireman; one discharge man; two concrete spreaders; one finishing machine operator and one man helping to finish.

Comparison and Discussion.—The crews compared, include only the force which varied with the method;

FIG. 3. DRY BATCH DISCHARGED INTO MIXER

the truck drivers, sub-grade men and turntable men remained the same whichever method was employed. Operating a four-bag batch paver and dry haulage the maximum rate of construction was 608 ft. in 10 hours and the average rate was 560 ft. With wet batch haulage and a two-bag batch mixer the average rate of construction was 420 ft. in 10 hours. Commenting on the records made by the two methods the contractors say:

The contractors feel that the wet batch method has advantages over the dry batch method, as in running 608 lin.ft., it is necessary to move the mixer at least thirty times the length of the boom during the day, the average

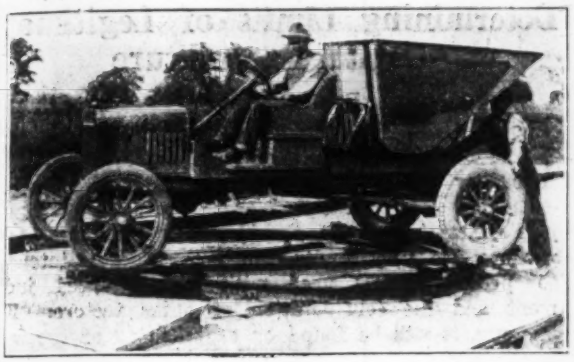


FIG. 4. ONE MAN OPERATES TRUCK TURNTABLE

time for a move being close to one minute. This one minute lost in moving thirty times totals a half-hour loss each day, under the most favorable conditions, and the labor required upon the road and at the bins is more than is required on the wet batch method. The contractors have been able to lay about one-third more yardage per day by the wet batch method than by the dry batch method, and have installed central mixing plants on their Clear Lake, Ia., paving contract, and are also placing the same type of plant on their contract at Cedar Rapids, Ia.

In operating the motor trucks on these two sections, the total fleet of twenty-six was split up according to the relative lengths of haul. To keep both jobs moving evenly the work was planned so that when the haul was long on one job it was short on the other job. The average haul for both jobs was 2½ mi. On the wet batch section a maximum haul of 3.4 mi. was entirely successful, but the conclusion from experience is that the ideal haul for wet mix over ordinary roads is 2½ mi.

Generally the grading on each section was kept about 2,000 ft. ahead of the concreting. This distance gave ample leeway for grading, subgrade preparation and form setting; kept the haul over grade and subgrade within moderate lengths, and, consequently, left the greatest possible length of haul over the original road. Using solid tires the subgrade was considerably cut and rutted by the hauling, but this was nearly all eliminated when the trucks had been equipped with oversize pneumatic tires. Another aid of importance in keeping the subgrade unmarred, and, also, a help to speed and a saving in wear and tear on the trucks in reversing to back up to dumping position, was a turntable arranged as shown by Fig. 4. One man operated this turntable.

Truck haulage required close attention to schedules. Schedule maintenance consisted largely in training the drivers, but certain checks were found helpful. Each truck was supposed to report at the loading station within a certain period of time after departure with a load. Its arrival at destination was also checked. The rule that whenever the track was standing idle the motor must be shut off also discouraged bunching the trucks, since each stop meant that to start again the driver had to dismount and crank his motor and as he disliked to do this he endeavored to keep to schedule.

On the work described F. J. Colosey is in charge for the contractors, with C. G. McHugh as field engineer, and Harry H. Toothacher and A. B. Snow in charge of inspection for the State Highway Department under E. J. Finnell, resident engineer. The contractor was the Henry W. Horst Co., Rock Island, Ill.

Advantages and Disadvantages of Municipal Street Cleaning

SOME of the advantages and disadvantages of street cleaning and refuse collection by contract and also by the city direct are summarized in the report on street cleaning and allied matters at Philadelphia, noted on p. 236 of our issue of July 29. Extracts from the report, which was made by E. B. Morden, chief of the Bureau of Street Cleaning, James W. Follin, engineer, Philadelphia Bureau of Municipal Research, and J. H. Neeson, principal assistant engineer, Bureau of Highways, follow:

It is perfectly clear that no contract is on a sound basis unless, (1) the work to be performed is definitely specified so that the bidder can determine the cost of performance and bid intelligently, and (2) unless it is possible for the party paying for the work to determine if the work specified has been performed.

Disadvantages of Philadelphia Contract

The existing contract for street cleaning is disadvantageous for the following reasons:

1. It is humanly impossible completely and definitely to specify the work to be performed, for although the frequency of cleaning can be given, standards of cleanliness are not possible of definition, and the results of the street cleaning must be judged without definite specifications, and therefore,

2. It is necessary for the bidder to pad the contract price to provide against possible unfriendly attitude on the part of the bureau chief who is the judge of the work performed, and of other officials.

3. The contractor is sometimes forced by unfavorable circumstances to attempt to control the city inspection forces, and there is an ever present temptation to influence their reports for a consideration.

4. Undue authority is given to the bureau chief to judge the results of the work performed, and he is in a position either to make or to break the contractor as he wills.

5. It is difficult to determine whether the streets are properly cleaned because of the intangible results, and the fact that the streets do not stay clean very long after the cleaners have been over them.

6. It is difficult to obtain practical and dependable inspectors.

7. The city is unwilling to pay salaries to the street cleaning inspectors commensurate with the responsibilities involved in work of such an intangible nature, thereby putting a premium upon inefficiency and dishonesty.

8. It is impossible to guarantee to the contractor that the public as a whole will obey existing ordinances, thereby throwing the burden of their disobedience on the contractor, who has this indeterminate factor to take into consideration in making his bid.

9. The contractor is tempted to slight the work by racing his equipment and speeding up his gangs, thereby covering the streets with the specified frequency, but only imperfectly.

10. It is impossible to obtain flexibility under any form of specifications to permit extensive modifications of performance such as are required by seasonal variations or emergency shifting of forces from one district to another.

11. It is necessary for the bidder either to amortize his plant and equipment during the life of the contract, thus adding an excessive amount to the bid, or to insure by some other means that the contract will be renewed and new competition discouraged.

12. It is necessary for the contractor to add a high contingent cost to his bid to cover the greatest conceivable advances in the labor and material markets.

13. The cost is increased by dual supervision by contractor and the city.

Municipal operation of street cleaning work overcomes the majority of the objections to the existing contract performance listed above, but naturally has certain inherent disadvantages of its own. The advantages of municipal operation are as follows:

1. Flexibility of organization, with ability to concentrate the force in emergencies and to revise methods and schedules to meet changing conditions that cannot be foreseen when contracts are let.
2. The placing of the city bureau organization on a business-like basis, actually performing the work, and abolishing the rewardless task of attempting to keep the contractor's work under control.
3. The substitution for the underpaid and unsatisfactory city street cleaning inspection force with superintendents and foremen who actually direct the work and get results, with actual economy from the abolition of costly dual inspection essential to contract work.
4. Actual saving of money to the city by eliminating the contingent fund included by the contractor in the bid price to guard against unfriendly or unreasonable action by the bureau chief in enforcing the specifications.
5. Actual saving of money to the city in carrying its own insurance against advances in the labor and material markets for which the bidder may make more than the necessary provision.
6. Accomplishment of the maximum possible amount of work for the money appropriated by Council, since municipal work is at cost.
7. Avoidance of nonequitable contracts and possible expensive controversies in the courts.
8. Possible securing of better co-operation from the public in their care of the highways because of the sympathetic attitude of the public toward municipal work.
9. Opportunity for continuous study of conditions and for making beneficial changes in equipment and methods.
10. Direct and absolute control of the working forces.

Municipal operation is subject to certain disadvantages which can be successfully overcome:

1. The present inability to obtain experienced and properly qualified employees with dispatch through the Civil Service Commission.
2. The possible failure of the proper authorities to appreciate the need of sufficient funds to carry on the work and maintain the equipment, which might cause the service rendered to the public to be unsatisfactory.
3. Possible decreased efficiency of the labor because the foremen-supervisors are not actuated by the incentive of increased profits which exists in contract performance.

Contract work has certain inherent advantages:

The contractor is able to purchase equipment and materials directly on the basis of practical judgment and without the competitive bidding in force in the city, thus saving delays and securing the most desirable equipment and materials.

2. The contractor is able to compensate supervising employees properly and to increase their salaries immediately to keep them from accepting more lucrative positions and, besides, can offer them special inducements.
3. The contractor can regulate wages and salaries without the complicated procedure required in municipal work.
4. The contractor can hire and discharge employees without restriction or regulation, such as civil service control.

In the case of street-cleaning work, the disadvantages of contract performances are so numerous and so overwhelming that the argument of possible increased labor efficiency under contract work is relatively unimportant. Municipal operation is the only proper method, and every effort must be made to overcome any disadvantages inherent to it. Civil service control should be reasonable and not arbitrary; the city purchasing agent should co-operate to secure the most desirable equipment and materials and not merely the cheapest in price, and the salaries of supervisors and foremen must be fixed equal to those prevalent in outside employment.

Determining Limits of Legitimate Capital Expenditure

By J. R. Wade
New York City

In determining the limits of useful capital expenditure for any engineering work or program of industrial expansion the principle, that operating expenses plus interest charges should be a minimum, may produce the very faults which the rule is intended to prevent unless used with well balanced judgment and the consideration of other factors. For instance, it will be found on examination of the misfortunes of certain railroad corporations that disastrous results were due in part to the fallacy of continuing an endless chain of expansion and improvement on borrowed money as long as the net returns were sufficient merely to pay interest on the debt, without profit to the borrower and a proper factor of safety, so that the damage to the credit of the borrower outweighed the advantages gained.

The usual method of calculating the point of maximum economy in the determination of capital expenditures may lead a management bent on a policy of expansion to unjustified expenditure. It is the purpose of the following mathematical analysis to show that such errors may be due largely to disregarding the rate of increase of the interest rate on borrowed money, as the amount borrowed increases over a wide range. Fundamentally the rate of interest is a variable function of the amount borrowed affected by the following factors: More bonds may be offered for sale at a given interest rate than the market can absorb, forcing the price down and raising the interest rate on the proceeds; impaired credit of the borrower through increasing the ratio of the amount of money required to pay interest on the debt to the net earnings and decreased ratio of the value of the property to the amount of outstanding bonds will tend to raise the interest rate as the amount of borrowed capital increases; again, the interest rate to which increasing amounts of borrowed capital are subject is dependent on general financial conditions.

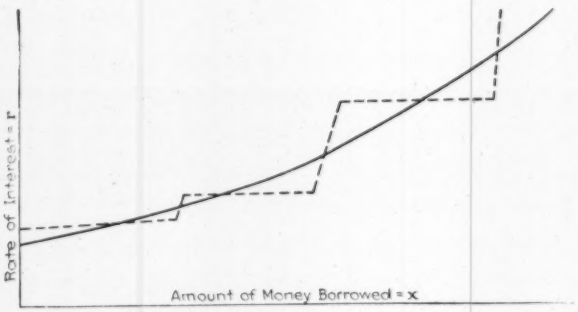


FIG. 1. INTEREST RATE IS VARIABLE OF AMOUNT BORROWED

With consideration of the above factors it should be possible to draw an approximate curve representing the rate of interest as a variable of the amount borrowed, as in Fig. 1, in which the heavy line represents the theoretical variation and the dotted line the probable actual variation as borrowing and expenditure increase.

Let, r = rate of interest
a = total annual interest charges
x = total amount borrowed for capital expenditure
e = estimated operating expenses.

Then the condition of maximum economy is described by the differential equation:

$$\frac{da}{dx} + \frac{de}{dx} = o,$$

as represented in Fig. 2. The curve for e can be approximately established by estimating the operating expenses for several programs of expansion or construction representing different amounts of capital expenditure, and the curve for a can be readily developed as a function of x from Fig. 1.

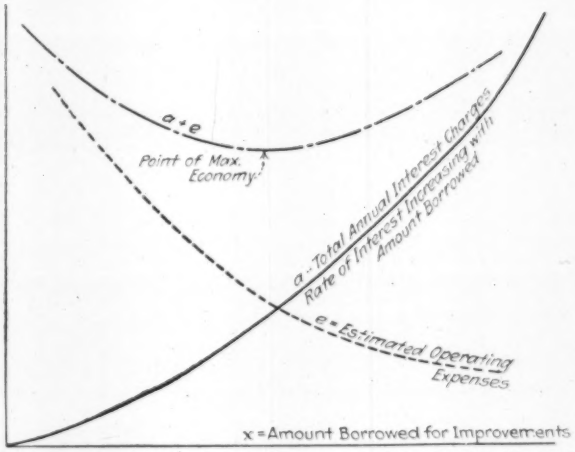

a+e
Point of Max. Economy
a=Total Annual Interest Charges Rate of Interest Increasing with Amount Borrowed
e=Estimated Operating Expenses
x=Amount Borrowed for Improvements

FIG. 2. RELATION OF VARIABLE INTEREST CHARGES AND OPERATING EXPENSES TO MAXIMUM ECONOMY

Since, $a = rx$,

$$\frac{da}{dx} = r + x\left(\frac{dr}{dx}\right).$$

Substituting this value of $\frac{da}{dx}$ in the above equation we arrive at the fundamental equation:

$$r + x\left(\frac{dr}{dx}\right) + \frac{de}{dx} = o.$$

While this equation will be readily conceded to represent the condition of greatest economy, the assumption is too often made that the term $x\left(\frac{dr}{dx}\right)$ may be neglected though this is true only when the amount of money to be borrowed is infinitely small or when the rate of interest on variable amounts is constant. A careful forecast of the curve represented by Fig. 1 will almost invariably indicate that the interest rate will be a variable where the amounts of expenditure under consideration are large, and an approximate value of $\frac{dr}{dx}$ can be determined. Now a constant based on the value of $x\left(\frac{dr}{dx}\right)$ may be developed so that an approximation of the fundamental equation may be represented thus:

$$Sr + \frac{de}{dx} = o,$$

where S may be considered a factor of safety. Such an approximate empirical equation may be found useful where it is difficult to solve the fundamental differential equation.

However, the development of the fundamental equation,

$$r + x\left(\frac{dr}{dx}\right) + \frac{de}{dx} = o,$$

indicates that the term $x\left(\frac{dr}{dx}\right)$ should not usually be neglected and the equation should not be written,

$$r + \frac{de}{dx} = o,$$

without the use of some such factor as S, to serve as an approximation of the true equation. Although the value of this factor may in many cases be in doubt, it would appear that as long as the ratio of net earnings to interest on debt remains constant the credit of the company should remain unimpaired, so that the ratio may, under certain circumstances, be the correct factor of safety, though in the case of a strong company of large earning power there would appear to be no necessity for the use of a factor nearly as large as the ratio of net earnings to the interest on debt.

Objection to this rule may be raised on the score that it is too conservative in that while the last dollar spent earns no more than enough to keep the ratio of interest to net earnings constant, some of the earlier expenditure is likely to be much more profitable and the credit of the company will be thereby improved, yet on the other hand it is well to recall that the increased supply of bonds is likely to depress the price, unless it can be shown that the nature of the security is improving, hence the use of a factor of safety as here suggested is probably not far wrong.

Record Traffic Through Panama Canal

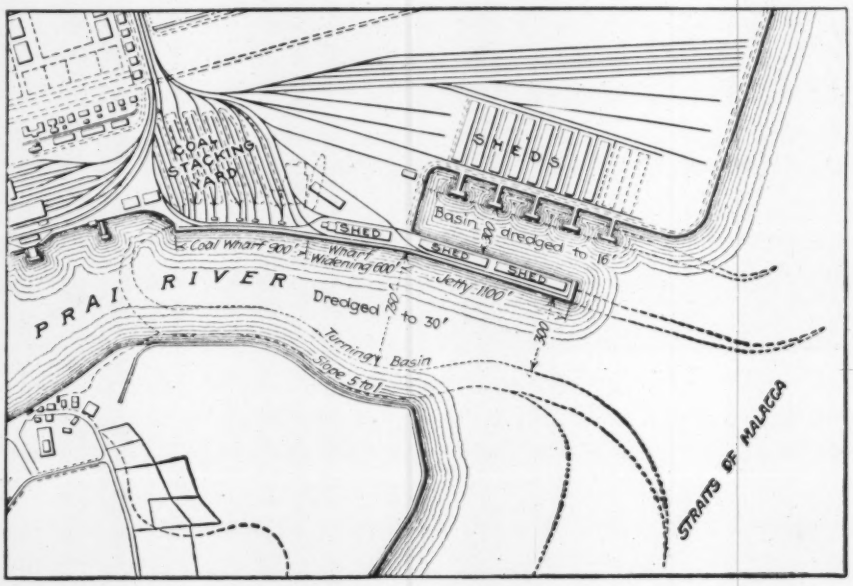
During the fiscal year ending June 30, 1920, the volume of traffic passing through the Panama Canal exceeded that in any previous 12-month period. A total of 2,478 commercial ships made the transit, as compared with 2,025 in the fiscal year 1918-19, 2,130 in the fiscal year 1917-18, and 2,134 in the calendar year 1919. The aggregate net tonnage of the commercial ships passing through the canal in the fiscal year 1920 was 8,545,653 tons, according to the Panama Canal rules of measurement. In the fiscal year 1918-19, the aggregate was 6,131,575 net tons. In addition to the traffic of commercial ships, 266 vessels passed through the canal in the service of the United States Government, without the payment of tolls. In revenues and in earnings in excess of expenses of operation and maintenance, new records were, likewise, established during the fiscal year. The summation of charges has not been completed in detail, but the figures indicate aggregate revenues approximating $8,800,000 during the year. Expenses of operation and maintenance total about $6,650,000. No profit has been made in a commercial sense, since there is no consideration here of interest charges on the investment or of the depreciation of the plant. The previous record for a year for revenues was made in the fiscal year 1918, in an amount of $6,411,843.28. In that year the excess of revenues over expenses amounted to $491,500.34, being greater than that in any fiscal year prior to the fiscal year 1920.

Precast Concrete Pieces Make Up Cylinder Piers For Wharf

Novel Type of Marine Structure Being Built in New Port Development in the Federated Malay States

CONCRETE cylinder piers made up of short precast sections are being used for the support of a reinforced-concrete wharf, or as it is locally called "jetty," in the new Prai River port development in the Province of Wellesley, the Federated Malay States. This port, which is at the mouth of the Prai River where it empties into the Strait of Malacca, has been growing in importance for a number of years. Just before the outbreak of the war a plan for enlargement was submitted to the government but its initiation was postponed until 1918. The work is well under way.

The entire project comprises deepening of the river channel, reclamation of swamp and foreshore, construction of quarters, building of a new dry dock, and, the main piece of work at present, the construction of a wharf which is in the form of a quay for a distance of about 1,500 ft. and which extends further a distance of 1,100 ft. out into the river which widens at this point. Inasmuch as the main channel of the river is to be dredged to a depth of 30 ft. and the marginal basin on the other side of the wharf to a depth of 16 ft., the structure here is in somewhat anomalous type. It is called at the project itself a "jetty," although it has none of the properties of the jetty as understood in this country. The upstream end of the structure is a coal wharf and is approached by tracks from an adjacent railway coal yard. The 600 ft. of shore wharf and 1,100 ft. of "jetty" have on them three two-story transit sheds, each 475 ft. long and 65 ft. wide, which are also approached by tracks from the adjacent railway yard and which will be used in the transshipment of freight to vessels. The whole project is described in *The Engineer*, April 30, 1920.



LOCATION OF NEW PIER IN THE PORT OF PRAI, FEDERATED MALAY STATES

Borings made in 1914 showed that under the river mud at the site of the wharf and at an average depth of about 50 ft. below low water there is an extensive layer of quartz sand going down to a great depth. Later borings made in search of water penetrated continuous layers of sand and gravel of varying degrees of coarseness to a depth of 320 ft. below low water when a hard, igneous rock was encountered. It was decided, therefore, to make the foundations for the wharf in the layer of sand and concrete cylinders were chosen in preference to screw piles on account of the rapid deterioration of steelwork in these waters. The wharf, therefore, is built on rows of concrete cylinders, seven in each row, spaced 25 ft. apart longitudinally and 22 ft. transversely. It has a total width of 142 ft., the coping level being 4 ft. above high water.

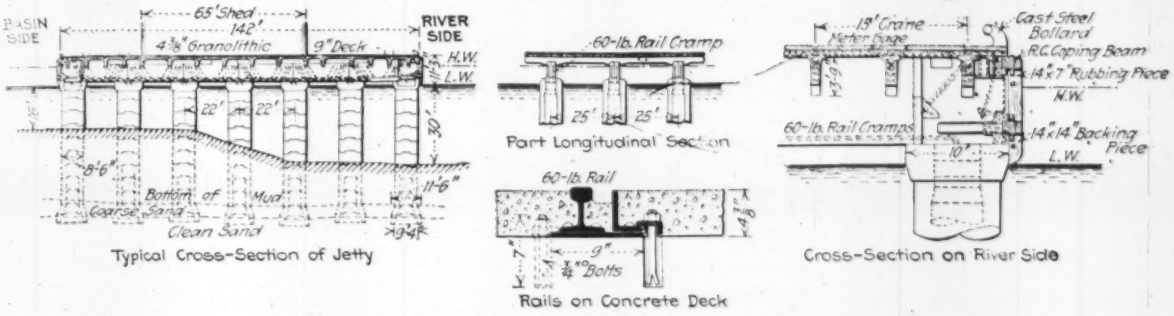
The cylinders for the supporting piers are built up in rings in a block yard and allowed to set for three months before being used in the work. Each ring weighs from 10 to 14 tons. For each cylinder there is a cutting edge ring 3 ft. 6 in. deep, 11 ft. 6 in. outside and 9 ft. 4 in. inside diameter. On top of this ring is placed a ring tapering from 11 ft. 6 in. to 8 ft. 6 in. outside, and to 5 ft. inside, and the latter dimensions are maintained for the ordinary rings forming the cylinder up to 1 ft. 6 in. below low water, these rings being 5 ft. in depth. A compensation ring made from measured dimensions brings the top to the required level. Special caps capable of a slight adjustment in alignment complete each cylinder at a height of 2 ft. above low water level. On these caps the reinforced-concrete superstructure is built.

The cylinders are sunk in steel guide sleeves fixed for the temporary stages by inside clam-shell excavation and by loading with cast-iron billets. The bottom cylinder is sunk until the cutting edge has penetrated 2 ft. into the layer of sand. A test load of 100 tons, in addition to the weight of the cylinder, is then applied and no cylinder is passed as satisfactory until it has stood 48 hr. without settlement under total load. This is equivalent to five tons per square foot or greater than the ultimate load that will come on the foundations. After each cylinder has been tested the cast-iron loading is removed, the bottom cleaned out by divers, and the core filled solid with 1:6 concrete to within 18 in. of the top of the cap.

When several rows of cylinders have been completed the superstructure is then proceeded with. The lower fender railings, also precast concrete, are placed in position on top of the front caps, forms for the mass concrete columns on top of the cylinders and the cap beams which brace the structure are placed in position, the steel reinforcement assembled, and the whole concreted with 1:6 concrete. The cap beams are 3 ft. 6 in. wide by 6 ft. 9 in. deep and extend from center to center of each cylinder with an expansion joint at each

They are reinforced with 1¼-in. diameter steel rods and stirrups, and at the bottom of each beam there are laid two 60 lb. British standard flat-bottom rails, bent downward at each end into collars fixed in the recesses left in the top of the cylinders.

The fender rails are braced by diagonal struts, the tail ends of which are housed in the cap beams and are grooved on the face to receive the lower horizontal fender. The main floor beams are set and grouted in recesses left in the top of the cap beams. They are 3



DETAILS OF REINFORCED-CONCRETE PIER AT PRAI RIVER MOUTH

ft. 9 in. deep at the ends and 2 ft. 9 in. deep at the central part and 12 in. wide. The reinforcement is made up of 1¼-in. diameter bars. A special coping beam is fixed on the sides and ends of the wharf and grooved to receive the upper horizontal fender.

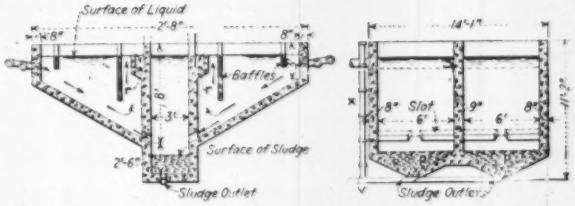
The floor over the whole wharf is 9 in. thick, with top and bottom longitudinal bars ¾ in. in diameter spaced 12 in. c. to c. Transverse bars are ⅝ in. diameter spaced 9 in. c. to c. with intermediate ⅝-in. bars under the track. Under the area to be occupied by the warehouses the spacing of the transverse bars is 6 in. c. to c. The top of the reinforced-concrete floor is finished off with a layer of 1:4 concrete 3½ in. thick on which is laid 1 in. of 1:2 granolithic concrete of fine granite screening, screeded off to the required level, the top layer being laid immediately after the lower one.

The concrete of the cutting ring of the cylinders is 1:3 mix and all the other rings 1:5 concrete. All reinforced concrete is made in the proportions of 90 lb. of cement to 1½ cu.ft. of sand and 2⅔ cu.ft. of crushed granite, the stone broken to assorted sizes not less than ⅛ in. and more than ⅝ in.

Three meter-gage tracks are laid on the river side and two on the basin side of the wharf, with frequent crossovers. Turntables are also fixed in wells specially formed in the reinforced-concrete superstructure on the cross-track between the warehouses, and at the end of the wharf for the transfer of single cars from one track to any other. The track rails and the rails for the 15-ft. gage electric cranes are laid at the same time as they were before mass concrete and granolithic surface. They are 60-lb. rails riveted to a ⅜-in. steel bed plate carrying also an angle guard rail, as shown in the accompanying detail. The development of the Prai River project was prepared by P. A. Anthony, general manager and chief engineer of the Federated Malay States Railways, and approved by Coode, Matthews, Fitzmaurice and Wilson, consulting engineers for the Straits Settlement and the Federated Malay States governments. Construction is going on under contract to Topham, Jones & Railton, Ltd.

Sewage Treatment at the Miami Conservancy Camps

THE application of a system of sewage treatment to the needs of the Miami Conservancy camps naturally required special adaptation. The camps are small, the two largest built to accommodate a total maximum camp population of about 500. For Conservancy use they would be operated about four years, after which the whole camp plant would have to be disposed of. The sites are all several miles from the nearest town or city, but in all cases except one are near railway or electric railway lines. Under such circumstances it was considered best to so design the camps that they could become permanent villages after the Conservancy work was done. The buildings are inexpensive one- or two-story structures of the summer cottage type, with water, electric and sewage facilities. The sewers are of the separate type.



IMHOFF TANKS MADE SHALLOW FOR ECONOMY GIVE RESULT

For sewage treatment a standard pattern of Imhoff tank would cost too much, largely on account of the depth necessary, approximating 30 ft., requiring expensive excavation, since the tanks must be below street sewer level, in order to receive the sewage by gravity flow. It was for this reason that the design indicated was adopted. By locating the greater part of the sludge chamber between the two sedimentation chambers, instead of below them, a great saving in depth was obtained, while at the same time the sludge decomposition was completely separated from the fresh liquid sewage.

The Conservancy tanks show a depth below the surface of the liquid of 9½ ft., and after being in use more than a year create no perceptible odor even in the near neighborhood.

The maximum number of men to be provided for at Englewood and Taylorsville, the two largest camps, may be 300. With their families, most of them not being married, this might make a total camp population in each of these cases, of 500. At 7 cu.ft. per second per thousand people, the Stillwater River at Englewood (below West Milton), would take care of a population of 3,500, seven times the maximum camp population, without sewage treatment. Similarly at Taylorsville, the Miami would take care of 10,000 people; Mad River at Huffman, of 28,000 people, Loramie Creek of 1,268, and Twin Creek of 1,428. With the known conditions, the danger of creating a nuisance is remote.—*Miami Conservancy Bulletin.*

A View on British Registration of Engineers

IN A communication in the July 23 issue of *The Surveyor* (London) Percy Griffith, member of the Institution of Civil Engineers and other national organizations and recently secretary of the Institution of Water Engineers, discusses the present status of British engineer registration. He emphasizes particularly the opportunity which is believed to exist for an effective co-ordination of the work now being carried on by a large number of engineering institutions. His letter follows:

Now that the Institution of Civil Engineers has accepted the principle of registration as the proper, if not the only, means of securing general compliance with a standard of qualifications adequate to safeguard the interests of the public on the one hand, and to maintain the prestige of the profession on the other, it seems to me that a golden opportunity offers for an effective co-ordination of the work now being carried on by a large number of engineering institutions. At the moment each of these bodies is struggling to secure for its members special advantages which may not only justify the payment of the annual subscription, but also attract new members, and the resulting disadvantages are sufficiently obvious to require no elaborate statement. Briefly, however, they include the following: (*a*) Multiplication of subscriptions; (*b*) overlapping in subjects discussed; and (*c*) distribution of literary matter, models, specimens and other data required by engineers from time to time among a vast number of centers, located without any consideration of general accessibility.

The difficulty of geographical distribution is being partly met by the formation of "local branches" in various provincial towns, but the attempt of the London institutions to establish local branches in the Colonies has been finally checked by the establishment of independent institutions in India, Canada and Australia, representing all branches of the profession, and each providing schemes of registration which ensure to the members not only public recognition, but security against unfair competition by unqualified men.

These facts will suffice to emphasize the feeling, which has been growing rapidly in recent years, and especially during and since the war, that something should be done to co-ordinate the labors of English engineers practicing at home, but the difficulties which have arisen in connection with the Civil Engineers (Registration) Bill, promoted this session, but definitely held over for the present, have clearly revealed the impossibility of attaining the object in view so long as the initiative is retained in the hands of one institution. We all recognize the seniority and prestige of the Institution of Civil Engineers, but, unfortunately, we do not quite understand what is meant by the term "civil engineer;" moreover, we all (or nearly all) belong to some other (sectional) institution or society which specializes in the particular branch we are engaged in, and whatever value may attach to our Institution of Civil Engineers' certificate, we still prize our certificates proving us to be specialists in our own branch as highly. Registration under the Civil Engineers' scheme would therefore give us little more prestige than we gain from our present certificates as "members" or "associate-members," and the only advantage left would be the elimination of the unqualified competitor. It is, however, not certain that we should even secure this, as anyone could practice as an electrical, gas, water, or sanitary engineer so long as he did not call himself a civil engineer as well.

It is no doubt under consideration to provide some means of recognizing the specialist in the registration scheme, but, unfortunately, we have another large and influential institution, whose title is almost as vague and ill-defined as that of the senior institution—namely, the Institution of Mechanical Engineers. Moreover, the interests of these two institutions are so similar that their very existence side by side entails an element of competition and rivalry which the best intentions of their respective councils cannot entirely eliminate or overcome. As regards registration, the claims to dominate the situation are nearly equal, and many no doubt would, on personal grounds, prefer to trust their fate to the "mechanicals" rather than to the "civils." We should, I think, most of us agree in attributing this feeling to the fact that the junior institution is more "human" than the senior, and possibly, in many cases, the term "up-to-date" would be accepted as nearer the truth than the term "human."

Assuming, however, that the two senior institutions can find some means of acting together in this important matter, we shall be in a position to consider "registration of engineers" on broad, comprehensive lines, and then we can face the problem involved by the claims of the admittedly sectional institutions. With this in view, it is worth while to realize their specific functions more clearly than has been generally done. For many years past the Society of Engineers, which was established in the year 1854, and therefore follows the Institution of Mechanical Engineers as regards seniority, has been working in the direction of registration for all classes of engineers; but, owing to its relatively small membership and the want of prominent "personalities," its labors have been unfruitful. Meantime it has, by a praiseworthy act of self-abnegation, induced the Institution of Municipal and County Engineers and the Institution of Water Engineers to initiate schemes for testing and vouching for the qualifications of their members.

To this extent, at least, we have the materials at hand for framing a comprehensive scheme of registration. The two leading institutions should undoubtedly together form the permanent nucleus of the governing body, and become the registering council or authority, but their certificates of competency should be restricted to (*a*) general engineering knowledge, and (*b*) special experience in branches not at present represented by any sectional institution. In the the case of certificates for general engineering knowledge only, registration should not be conceded except in a separate class, and the registration certificate should be clearly differentiated, but it would be certainly preferable that registration should be restricted to those obtaining certificate (*b*), and then the nature of the experience obtained should be stated quite specifically. In all cases where the candidates had qualified in some branch represented by an existing institution, the scheme could provide for registration being granted to anyone holding a certificate issued by the sectional institution in question, subject only to the examination or other test on the strength of which the certificate was granted—being approved by the governing body. To secure the necessary supervision and control, it might easily be arranged that the governing body should have power to nominate representatives on the sectional board of examiners in each case.

Registration certificates would then be issued to all classes of engineers with the particular section or sections in which qualifying certificates had been obtained stated as a supplementary classifying title. The mention of two or even three sections on the certificate would be no serious difficulty. Needless to say, the vague terms "civil engineer" and "mechanical engineer" would disappear into the "limbo of a forgotten past."

So much for registration. But I would point out, with all the emphasis at my command, that in negotiating such a scheme as this, the foundation would be laid for a comprehensive co-ordination of the whole profession, the superstructure of which would be comparatively easy of design and erection owing to its manifest advantages. I cannot enlarge upon this without unduly encroaching upon your space; but it will suffice to indicate summarily some of the possibilities:

1. A central building with a central engineering library (both "lending" and "reference") in Westminster.

2. Provincial engineering centers in the chief cities outside London with smaller libraries (for "reference" only).

3. Engineering clubs attached to the building in each case, with social functions arranged from time to time.

4. Central meeting halls available for all sections and possibly sectional headquarters (secretariat) in the same block.

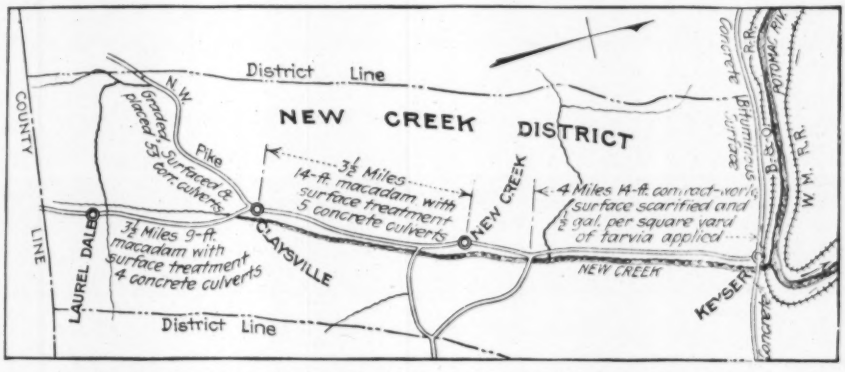
... Sectional employment bureaus, with sections for ...ers or assistants having only general experience. ...These, are, however, but feeble illustrations of the advantages of co-ordination among professional engineers, and I venture to hope that some of our leading men will seize this opportunity of initiating a movement worthy of our prestige, our ability, and our destiny.

County Roads Constructed Cheaply by Day Labor

Farm Boys and Old Men Unfit for Military Service Make Fairly Efficient Macadam Road Builders

By Samuel H. Lea
County Engineer, Keyser, W. Va.

SUCCESSFUL highway improvement by force account, with local labor under the unpaid direction of a local business man, has been accomplished during the three seasons prior to 1920 in Mineral County, W. Va. While the construction performed was not notable in magnitude it was of a kind with which many communities are concerned. Incidentally, one part of the construction was by contract, so that a cost comparison with the force account work is possible. The sketch map indicates the roads improved, the town of Keyser being the headquarters for the direction of the work. There were altogether 13½ mi. of road divided as follows: 5 mi. graded and macadamized to a width of 14 ft. with a surface treatment of ½-gal. of refined tar per square yard; 3½ mi. graded and macadamized to a width of 9 ft. with a surface treatment of ½-gal. of refined tar per square yard; and 5 mi. of mountain road (Northwestern Pike) graded and surfaced. In addition, the road south from Keyser for a distance of 4 mi. was resurfaced to a width of 14 ft. with a surface treatment of ½-gal. of refined tar per square yard. This latter work was done under contract at cost-plus 10 per cent. The total cost was $11,387.59, or $0.346 per square yard.



MINERAL COUNTY, WEST VIRGINIA, FORCE ACCOUNT ROAD SYSTEM

The county owned considerable road machinery; good stone was obtainable locally and a comparatively small portion of the construction material required railroad shipment.

The equipment employed consisted of a portable rock crusher, with screens and bins; one 4-ton motor truck, with dump body; one light runabout for the timekeeper; one 10-ton steam roller; four dump wagons and two carts; two 18-hp. boilers; two steam drills, and wheelbarrows, hand tools, etc.

Three foremen were employed at a flat rate of $100 per month each. One foreman supervised the quarry operations; one had charge of grading and preparing subgrade, and one looked after the construction of the macadam roadway. The engineering was done by a private firm at the rate of 4½ per cent of the cost of the completed work. A timekeeper was employed at $100 per month. He was given a light runabout and, in addition to keeping the time of workmen, he made out payrolls and monthly statements, attended to local purchases of supplies and carried orders and messages to different parts of the work.

Laborers were obtained mostly from adjacent farms. On account of war conditions old men and boys and men who were unfitted for military service comprised the working force. They were paid wages of $2.25 to $2.50 per day and the efficiency obtained was at least equal to that of some of the higher-priced laborers at the war construction camps.

The macadam was placed upon a rolled subgrade and compacted by rolling to a depth of 8 in. Shoulders of earth and broken stone were made about 3 ft. wide. Upon the macadam roadway a surface treatment was applied, consisting of ½-gal. of refined tar and about 20 lb. of stone chips per square yard of surface. The chips were in sizes from ½ in. to 1 in. The lump sum costs are given in the table which is reproduced below.

The unit costs, allowing interest and depreciation, were as follows: waterbound macadam, $0.793 per square yard; surface treatment with ½-gal. refined tar and 20 lb. chips, $0.187 per square yard; corrugated metal culverts, 15 in. to 30 in. diameter, furnished and installed, $3.37 per linear foot; concrete culverts $15.60 per cubic yard of concrete.

LUMP SUM COSTS OF ROAD CONSTRUCTION BY FORCE ACCOUNT IN MINERAL COUNTY, W. VA.

Five miles waterbound macadam, 14 ft. wide, 8 in. thick..	$36,757.91
Three and a half miles waterbound macadam, 9 ft. wide, 8 in. thick	14,360.62
Five miles grading and surfacing (Northwestern Pike)	4,629.35
Fifty-three corrugated metal culverts furnished and installed	3,235.20
Nine concrete culverts	6,893.40
Surface treatment with refined tar to waterbound macadam	12,101.41
Engineering supervision, 4½ per cent	3,509.00
Interest and depreciation on plant, 20 per cent on $6,000	1,200.00
Total cost	$82,686.89

The funds were obtained by the sale of district road bonds.

The work was under the direction of a local advisory committee whose chairman, J. C. Watson, a business man of Keyser, supervised all expenditures and directed operations. This service, rendered without compensation, resulted in a successful and economical consummation of highway improvement work of considerable magnitude.

Japan's Railway Progress Under State Ownership

Private Lines with Majority of Mileage Acquired in One Year—Extension and Improvement to Form Unified System

TEN years of railway development in Japan under the law for nationalization of the railways have shown results distinctly favorable to government ownership as compared with the previous combination of government and private ownership. This is the general substance of a comprehensive report issued by the Imperial Government Railways of Japan. The law in question was passed in March, 1906, and the acquisition of the leading private lines had been completed by October, 1917. This naturalization was not a revolutionary change in the government's policy of railway administration, but was rather an expansion of the existing state railway system by incorporating into it the separate private lines.

First Railways Built by State

In Japan the first railways were built by the state and it was not until 1881 that owing to difficulties in raising capital the Government decided to depart from its policy and grant concessions to private companies for the construction of railways. At that time the Government had built 115 miles. In 1891 the private companies had built 1,165 miles, while the state system did not exceed 557 miles, but the former had been assisted by government guarantees of interest and by cash subsidies. The first concessions were for 99 years, with provision for purchase by the state after 50 years, but in the year 1887 the purchase period was reduced to 25 years and guarantee of interest was withdrawn for all the new projects.

It was considered in 1891 that a network of 3,600 miles was necessary to complete a railway system adequately serving the whole country, but the existing mileage was only about 1,600 miles. Most of the contemplated extensions were in remote districts, giving little prospect of immediate profit, and therefore they did not appeal to private capital. This condition, combined with financial failure of some of the private companies, led to the initiation of a movement in favor of government ownership of the entire system.

Meanwhile construction was continued by both the government and the companies, so that at the beginning of 1906 the former had 1,536 miles and the latter 3,248 miles. During this period the consolidation of the lines was considered at various times, but although there was a strong majority opinion in favor of government ownership there was division of opinion as to whether government or private operation was preferable. In the business depression of 1898-99 several companies were dissolved, but thirty-eight existed in 1906 and their 3,248 miles of railway were made up largely of short and disconnected lines. Some of the more important routes, therefore, included parts of the government lines and parts of different private lines throughout the country.

The railway nationalization law passed in 1906 provided for government ownership of all except local lines and for the purchase of the seventeen main private railways by 1915, but within a few months this purchase period was reduced to one year. These railways aggregated 2,824 miles.

The present organization of the Imperial Government Railways is headed by a minister of railways, a vice-minister and an engineer in chief. Under this administration are the six departments of finance, engineering, mechanical engineering, traffic, private railways and business affairs. The operating organization is on the divisional system. The financial program, covering the period up to 1928, provides for annual expenditures of from $5,000,000 to $12,000,000,000 for construction and from $2,500,000 to $18,000,000 for improvements. These figures are based on a 50c. value in the rate of exchange for the "yen."

In 1917 Japan had 5,857 miles of state railways with 9,029 miles of track, while the private local lines brought the railway total to 7,621 miles. This total is equivalent to 13.80 miles per 100,000 inhabitants and 5.16 per 100 square miles of area. All main lines are of 3½-ft. gage and the heaviest rails weigh 70 lb. per yd. The equipment included 2,725 locomotives (12 electric), 6,867 passenger cars (125 electric and 22 steam motor cars), and 196,419 freight cars. With reference to the sudden demands upon the transportation system consequent upon the European war the report states that "but for the unity of management under a single authority the railways might have experienced serious embarrassment, if not utter collapse, owing to the phenomenal flood of traffic forced upon them."

Recent Improvements

Engineering difficulties have been numerous in carrying out the extensions planned under the new law to link up the lines of 1906 into a comprehensive and interconnected system. Owing to the mountainous character of the country grades of 1 to 3 per cent are frequent, with heavy curvature, heavy earthwork and numerous tunnels and bridges. New stations, city terminals, freight yards, car ferries, shops and extensive signal equipment are among the many works included in the development of the railway system from 1906 to 1918, and similar works are still in progress. Electrification has been applied at several points for suburban and main line traffic. It includes the rack-rail section of the Usui Pass, with grades of 6.7 per cent, where steam operation in the numerous long tunnels was a serious trial to enginemen and passengers owing to the inadequate ventilation.

Extensive improvements have been carried out also on existing lines, including grade reduction and double tracking. Two important grade reduction works of heavy character are now in progress; one will eliminate a mountain crossing with grades of 1.4 to 2.30 per cent and provide a low-level line with grades of 0.3 to 0.7 per cent, but this work involves a 5-mile tunnel. The other work is of a similar character, substituting a tunnel line with 1 per cent grades for an open-pass line with grades of 2.5 per cent.

Scientific railway engineering has received a large share of attention in the scheme of railway development. This work is under the direction of the Research Office, which has laboratories for chemical, electrical and timber study, a locomotive testing plant and a fuel testing plant. This office is in turn included in the business department and has charge of all the local laboratories.

Seepage and Waste Water Losses on Wapato Irrigation Project

Drainage Ditches to Relieve Alkalied and Swamped Lands Give Measured Flow of 60 Per Cent of Applied Irrigation Water

By L. W. Holt
Supervising Engineer, U. S. Indian Service, Yakima, Wash.

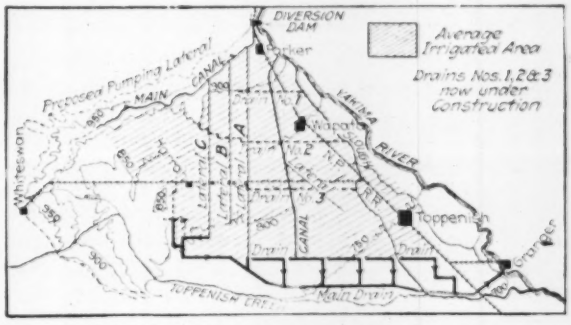
MEASUREMENTS of the flow from the drainage system of the Wapato Irrigation Project, Washington, show that as an average for the six years, 1913-19, about 60 per cent of the applied water reached the main drainage ditch.

The Wapato Project diverts water from the Yakima River six miles south of the city of Yakima, and is within the boundaries of the Yakima Indian Reservation. The first irrigation canal on that project was constructed by the U. S. Indian Service in 1896. It had a capacity of 300 sec. ft. In 1903 a canal with a capacity of approximately 1,000 sec.-ft. was constructed, diverting from the Yakima River at Union Gap near the northern boundary of the Reservation.

The soil is locally called volcanic ash, 2 to 5 ft. deep, underlaid with a stratum of loose gravel 25 to 50 ft. deep. The slope of the land is toward the south and averages 14 ft. to the mile. Toppenish Creek runs east at the extreme southern boundary of the project. The land immediately north of this creek has less fall and the soil generally speaking is somewhat deeper than the average on the project above. The annual rainfall is 7 inches.

In 1910 the alkalied and swamped lands had increased to such an extent and were so rapidly taking additional land to the north, that Congress appropriated $250,000 for draining the area thus swamped, which approximated 40,000 acres, some of which, however, had never been irrigated.

Until that time it was believed that this land could be drained by dredging out Toppenish Creek. The Board of Engineers investigating this matter (W. H. Code, chief engineer, U. S. Indian Service; C. G. Elliott, chief drainage engineer, U. S. Department of Agriculture, C. H. Swigart, supervising engineer, U. S. Reclamation Service, and J. W. Martin, superintendent of irrigation, U. S. Indian Service) was of the opinion that owing to the many bends in the creek and the fact that the land had less fall adjacent to the creek than at a distance that it would be better to locate the main



IRRIGATION AND DRAINAGE SYSTEM, WAPATO PROJECT

drain approximately one-half mile north of and paralleling Toppenish Creek, with lateral drains constructed 1½ miles north of the main drain and emptying into the main drain at intervals of about two miles.

A dredge with a 1-yd. bucket and a dragline excavator with a 1½-yd. bucket were purchased and the work was begun during the summer of 1910. Later a dragline machine with 1-yd. bucket was leased. The work was practically finished by the middle of the summer of 1912. However, so much water was encountered in the drain that it was deemed wise to enlarge the main drain from the outlet at Yakima River back three miles to the first main lateral and two miles of this lateral. This work was completed in December, 1912. In all, 42 miles of drains were constructed.

As soon as the construction work was completed a gage was established near the outlet of the drain. It has been read daily, with slight interruption since that time, and weekly current meter measurements have been made. The discharge from this drain was so large and so uniform that I believe the record given in the table will be of interest to irrigation and drainage engineers.

In preparing the table in the form given it was necessary to make certain assumptions and estimate corrections. One of these was that the irrigation water found its way to the drains on May 1 of each year, or one month after irrigation water was turned into the irrigation ditches, as May was the first month to show any increase over previous months most years. On two or three different occasions flood water from the overflow of Toppenish Creek and the Yakima River found its way into the drain and corrections have been made for those months. Also certain deductions have

MONTHLY DISCHARGE FROM MAIN DRAINAGE DITCH, WAPATO IRRIGATION PROJECT, WASHINGTON

Year	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Total	Acres Irrigated	Acre-Ft. Applied	Discharge Through Drains: Depth, Acre-Ft.	Discharge Through Drains: Depth in Feet per Acre Irrigated	Discharge Through Drains: % of Water Applied
1913	12,558	12,048	11,080	10,709	11,082	13,518	12,361	12,105	13,343	11,647	12,345	12,024	144,820	35,868	234,880	6.6	4.0	60
1914	13,591	12,246	12,119	10,925	12,418	14,194	12,881	12,254	11,679	11,284	12,274	10,678	146,543	36,000	234,424	6.5	4.0	61
1915	11,140	10,108	9,733	9,298	8,844	10,126	10,572	10,493	12,000	10,080	11,000	13,000	126,394	37,424	187,600c	5.0	3.4	68
1916	20,000a	19,632	18,616	14,121	15,314	13,672	12,278	12,005	11,488	10,119	10,526	10,182	167,953	44,712	279,849	6.2	3.7	61
1917	17,061	19,547	17,025	16,438	17,677	15,199	15,971	21,274a	25,555a	16,037	14,746	14,875	211,405a	53,790d	350,892	6.5	3.8	58
1918	15,974	18,421	17,143	18,949	18,919	17,732	14,770	12,666	12,600b	12,600b	12,600b	14,080	196,974	60,223d	363,137	6.0	3.4	57
															Average,	6.1	3.7	60

a Includes some flood waters in drains.
b Discharge estimated.
c Does not include November irrigation.
d 2,500 acres should be deducted from area irrigated in 1917 and 4,500 acres deducted from area irrigated in 1918.

been made in the irrigated area draining into other outlets. The table mentioned above is attached hereto.

It will be noted that the percent of the water applied to the land irrigated that was discharged through the drains averaged 60% and was very uniform with the exception of 1915. That year was the driest on record in the valley and the greater percent of runoff that season can be accounted for only by assuming that no record was kept of the diversion for irrigation after Oct. 31, as there was thereafter sufficient water for all purposes. Water was used, however, for irrigation throughout the month of November and at least 10,000 acre-feet used on the land of which no record was kept.

The table shows that on an average 3.7 acre-ft. of the 6.1 acre-ft. applied to each acre was lost by deep percolation and through waste-water ditches, and that at least 90% of the total loss was by deep percolation. This shows that nearly 30 in. of irrigation water was used on each acre irrigated and lost by evaporation. This is what might be expected, for, if we had a 30-in. rainfall distributed uniformly over the irrigated area from April 1 until Oct. 31—the length of the irrigation season—irrigation would not be required.

The writer has continually tried to increase the duty of irrigation water, but owing to the fact that 40,000 acres of the land irrigated are leased from the Indians, and the average lessee tries to get as much out of the land as possible at the least expense, consequently neglecting to properly prepare the land for irrigation, increasing the duty is a very difficult thing to do.

The 42 miles of drainage canals were measured at one-mile intervals one winter, and at that time the average increase in the flow was 5 sec.-ft. per mile, being slightly more on the east and west drains than on those running north and south.

The project is very productive, and even though an excessive amount of water was used, the 60,000 acres of land irrigated produced a crop in 1918 valued at $6,000,000 and estimated at $10,000,000 for 1919.

The irrigation system is being rebuilt and increased to irrigate 120,000 acres as fast as funds are provided by Congress, and an adequate drainage system is now being constructed along with the irrigation work. Much of the land formerly alkalied has been reclaimed and is now very productive.

Congress has recently appropriated sufficient funds to enable the Indian Irrigation Service to proceed with the development of the project on a larger scale than heretofore. At this time five dragline excavating machines are at work on irrigation and drainage canals. The work when completed will, no doubt, affect the flow of the drains heretofore described.

Previous to beginning the drainage work now under construction the ground water rose dangerously near to the surface of the ground in many places during the latter part of the irrigation season, which if allowed to go unchecked from year to year would gradually alkali and swamp a considerable area. It is believed that the proposed drains will prevent the ground water from rising to more than 8 ft. from the ground surface and will intercept some of the water which now reaches the drains described in this article.

Drainage canals are being constructed at approximately 2½-mile intervals, running east across the project, emptying at present into a large slough where the drainage water is used for irrigating land in the vicinity of Toppenish. Some of the drains now under construction intercepted a flow of 20 sec.-ft. per mile drain during the past summer.

When the larger project is completed the maintenance and operation charges will be fixed according to the number of acre feet used by each water user. This method will result in an increasing duty of water, the farmer will know that he is saving money.

A Tribute to the Engineer

The following editorial from the Cedar Rapids *Evening Gazette* has been brought to our attention by H. R. Green, an engineer of that city, who thinks the editorial, entitled "The Engineer" should be read by a wider circle of engineers than will see it in the *Gazette*:

Outside of the professor and the captain of industry few persons realize the evolution that has come in engineering. Plain humans have evolved but slowly in a half century, but today you find the engineer everywhere.

In all walks of production and industry except, perhaps, the industry of farming, the engineer is called in first. Few capitalists will risk their money and time on a project until competent engineers have gone over the ground thoroughly and indorsed it. Indeed, it is now a large practice for engineers of ability to seek out independently opportunities for the investment of capital or for the utilization of natural resources. Herbert Hoover himself is one of the successful examples of this latter class who are sure to grow in numbers and influence every year.

The engineer is becoming so important, as a matter of fact, that the day may not be long distant when he will take first place in industry and progress, the place occupied for centuries by the capitalist.

And will not the world be a better place for humans when that happens? The capitalist sits in his office by day, the lord of all he surveys, and at night associates with his own class. His chief affair in life is how to make money and how to spend it. In most cases he is totally materialistic—not entirely because he wants to be but because his environment and habits of life restrict him. He is cold spiritually because he doesn't mingle personally with the world's throngs. Thus when a problem comes to him involving masses of people he naturally trends to the materialistic side.

But the engineer! The very nature of his life's work carries him daily among the people, where he sees their problems, where he is often compelled to live as they live, work as they work and take risks that they take.

It is easy to recognize which man should have first place in this worldful of human beings—the capitalistic captain of industry or the engineer.

Mr. Green suggests that this tribute to the engineer, which he says is "unsolicited publicity," is due in part to the increased activities of the engineer in public affairs and probably to the organization of many local and state engineering societies.

Large Lumber Consumption During War

Approximately 6,500,000,000 ft., b.m. of lumber was used by the Government during the war, as shown by figures compiled by R. D. Bryant, industrial examiner of the United States Forest Service. Of this amount of lumber purchased directly by the various Government departments, the Army consumption was nearly 5,500,000,000 ft., the Navy consuming more than 120,000,000. During 1918 the Emergency Fleet Corporation consumed for ship construction approximately 800,000,000 ft. Lumber needed for boxes and crates alone required approximately 2,000,000,000 ft. Structures for cantonments, hospitals, warehouses, etc., used approximately 3,000,000,000 feet.

Notes from Foreign Fields

FROM GLASGOW TO LONDON

BY
E. J. Mehren
EDITOR ENGINEERING NEWS-RECORD

COMING down from Glasgow toward Liverpool I was treated to an experience that is rare in England—an all-night journey due to a washout. England experienced on the night of May 29 a severe storm. At Brock, below Lancaster, a small river crosses the right-of-way of the London & North-Western Railway. Normally a brook but five or six yards wide, it became a torrent and carried against the abutments and girders of the L. & N. W. bridge large trees, which dammed the waterway. A few hundred feet to the south is a highway undercrossing. Though well above usual high water the damming of the stream forced the water through this opening and the structure was washed out.

Though the failure occurred at 11 p.m. on Saturday, passengers for the south were blithely allowed to leave Glasgow on the 5 p.m. train Sunday, without being told that they would be subject to delay. On reaching Carlisle the news of the break got about. Though due in Preston at 10:30 p.m. we did not reach there until 3:40 a.m. Monday, and then only when the train was routed over the Midland Railway.

The amount of rainfall on the River Brock watershed I was unable to ascertain, but the gage at Preston, a few miles to the south, showed 2.82 in. between Saturday at 9 a.m. and Sunday at the same hour. Most of this fall occurred Saturday evening.

It was during the same night that the South disaster, in which 22 people lost their lives, occurred. The rainfall on that watershed was given at the coroner's inquest as 4.59 in. at one station and 4.70 in. at another in a 2½-hour period. A rivulet normally a yard wide and a foot deep was swollen to a width of 150 and a depth of 50 ft.

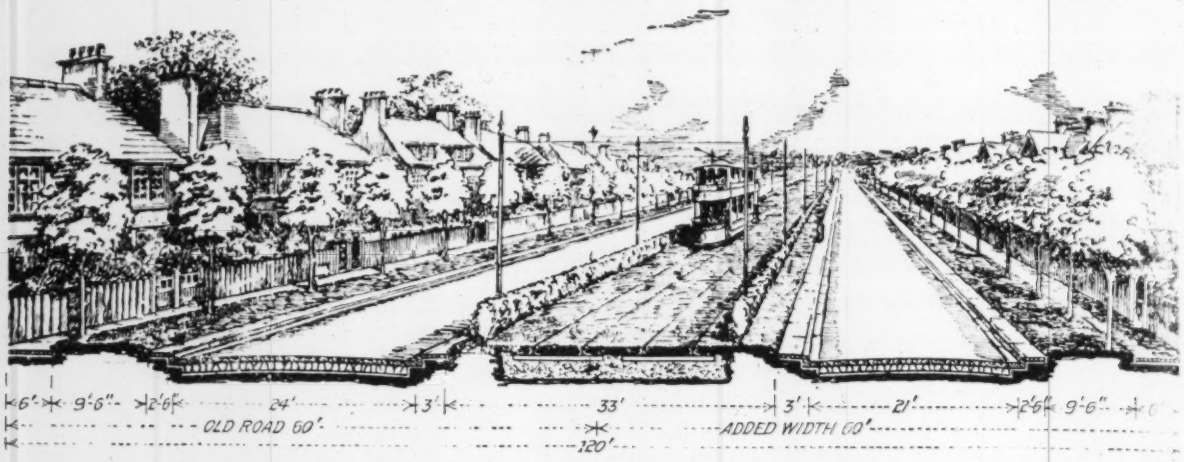
Liverpool — At Liverpool, the city engineer, Mr. John A. Brodie, who has recently been elected president of the Institution of Civil Engineers, showed me his plans for providing for the traffic of the future. Under his guidance Liverpool is taking time by the forelock and by providing liberal arterial ways and a ring-street in what is now sparsely built territory will save itself many millions in the future. In other words, Liverpool is benefiting by the experience of London and Paris.

JOHN A. BRODIE

For main arterial ways Mr. Brodie recommends a minimum width of 120 ft. This permits the laying out of two carriageways each 24 to 27 ft. wide, and a street-railway right-of-way of 30 to 33 ft., with the remainder in grassplots and footwalks. A cross-section of a street actually widened from 60 to 120 ft. is shown herewith.

AN ARTERIAL WAY 120 FT. WIDE, OF TYPE ADVOCATED BY MR. BRODIE

Mr. Brodie places much emphasis on the economies of putting the street railway on a right-of-way of its own. When this is done a cheaper form of track construction can be employed: rails on ties bedded in stone ballast, instead of the usual English construction of rails on steel ties on a concrete base. He has shown that with property values in Liverpool, even for land with buildings, it is cheaper to take an extra strip for the street railway than to lay the track in the carriageway. In other words, with the saving accruing from the cheaper form of track construction and the lower maintenance cost of the pavement due to the absence of rails, it is possible to buy the extra land for the railway right-of-way. Of course, the argument here appeals directly to

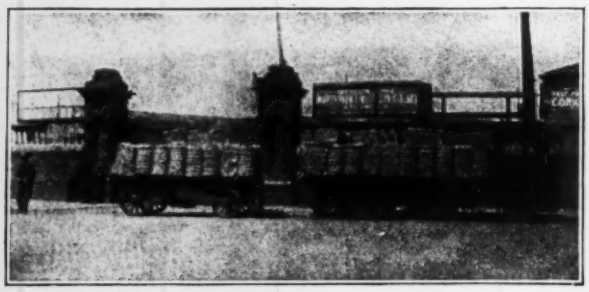


CROSS SECTION, SHOWING STREET WIDENED FROM 60 TO 120 FT. AT LIVERPOOL

the Corporation of Liverpool, for it owns the tramways, but the thought is worth passing on to our municipal officials and electric-railway operators.

The Queen's Drive, a ring road constructed under Mr. Brodie's direction, has already proved its value. Heavy commercial traffic uses it to avoid running through the heavily congested business district, formerly necessary to get from one side of the city to the other. Like the arterial ways, it has a minimum width of 120 ft.

In Liverpool I saw the heaviest traffic, taking weight



STEAM LORRY AND TRAILER, LIVERPOOL

and density into consideration, that I have seen in the United Kingdom. I think it equals that of any of our American cities. The steam lorry, in good favor everywhere in England, is here seen at its best. Invariably it hauls a trailer. Ten-ton loads on both lorry and trailer are common; in other words, the gross weight of the train will be about 30 long tons. The length of lorry and trailer is about 45 ft. Gasoline-driven trucks are used to a less extent than the steam vehicle, though this is merely a street observation, and is not based on records. In London, on the other hand, there are more gasoline than steam trucks.

Birmingham—At Birmingham, my last stop between Glasgow and London, the sewage disposal works and the refuse and garbage disposal system are of special interest. The sewage disposal plant is under the direction of John D. Watson, well known in the United States.

The main refuse-disposal plant, where refuse is picked over and incinerated and garbage reduced, is in a thickly settled part of the city, and while the odors within the plant are not pleasing the plant apparently is not a nuisance to its neighbors. Electrically driven carts are largely used for collection and are found economical as compared with horse-drawn traffic because of the larger district covered and the use for charging of the current generated by the incinerating plant. Among the products sold are rags of a number of classes, paper in three classifications, baled twine and rope, recovered solder and tin, detinned iron, glue, four kinds of fertilizer, destructor clinker, prepared mortar in which finely crushed clinker is used instead of sand, cement brick, sidewalk slabs and lawn rollers made with clinker aggregate. The demand for clinker is so heavy for use in filling and for concrete that a plant is being installed by which the entire handling from the furnaces, through the crushers, screens and bins into the carts, will be mechanical. Another improvement is the installation, now under way, of an electric detinning plant. Even with the sale of these by-products the plant does not pay all the expenses of operation, taking into consideration collection charges, the maintenance of collecting carts, plant, etc. The impression one gains is that everything possible is being done to get the values out of the material collected and that the operation is businesslike and efficient.

London, June 4, 1920.

No Relation Between Pellagra and Sanitation

Studies made by the U. S. Public Health Service show no relation between pellagra and sanitation. Among these studies was one of pellagra incidence in seven South Carolina mill villages, conducted by Joseph Goldberger, Surgeon U. S. Public Health Service and associates, the latter including R. E. Tarbett, sanitary engineer, who contributed sanitary ratings in tabular and graphic form. This study is presented in *Public Health Reports*, July 16, 1920, with the following conclusion:

This study of the relation of factors of sanitary importance to the incidence of pellagra in seven representative mill villages has failed to reveal any consistent correlation between them. Although based on a rather small mass of data and, in itself, not warranting any conclusions, it may, nevertheless, be noted as not without significance that this result, at any rate, affords no support for the view until recently, at least, quite widely entertained in this country, that pellagra is "an intestinal infection transmitted in much the same way as typhoid fever;" nor does the evidence adduced in favor of this view by other workers, when rightly considered, afford it any real support.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

The Makeup of Technical Books

BY R. FLEMING

American Bridge Co., New York City

Readers of technical books are of two classes—those who are pursuing courses of study and those who use them mainly as works of reference. This article is written with the latter class in mind. Information for the busy engineer should be so arranged that it can be found with the least expenditure of time and effort. This is an important consideration in the makeup of a technical book.

A book by a well-known engineer was reviewed a few years ago by another noted in the same profession. The review was exhaustive and of uncommon interest. The portion relating to the makeup of the book reviewed reads:

Its use for reference would have been facilitated also by sub-dividing the chapters into numbered articles or paragraphs with their particular titles printed in heavier type. These headings might also be placed at the top of the page instead of the senseless repetition of the general title of the book on every other page. This is a defect of make-up which is quite general in technical books and for which the printers are largely to blame. In the present work there are whole chapters without a single sub-head, so that the finding of any desired subject is made unnecessarily troublesome and time-consuming. This is further aggravated by the manner of reference to articles published elsewhere, by number of volume or periodical or journal instead of by date of publication, a sort of pedantry found also in the transactions and journals of engineering and other scientific societies.

The present writer has been particularly annoyed by the omission of the date of issue in references to periodicals. With only the volume number and page given the reader is at a loss to know until he looks it up whether the periodical referred to is sufficiently recent for the information contained to be of any value. Why can not references be given as follows?

Transactions Am. Soc. C. E., Vol. 32, Aug., 1894, p. 99.

Engineering News, Vol. 76, Dec. 21, 1916, p. 1171.

Engineering and Contracting, Vol. 47, Jan. 24, 1917, p. 89.

The importance of a good index can hardly be overrated, especially if the work is of any considerable magnitude. Thomas Fuller, the seventeenth century divine and historian, as quoted by Isaac Disraeli, observes: "An Index is a necessary implement and no impediment of a book except in the same sense wherein the carriages of an army are termed *Impedimenta*. Without this a large author is but a labyrinth without a clue to direct the reader therein." (It is too bad that Fuller did not have this more in mind in putting forth his own voluminous writings.)

Some sentences from "A Manual for Writers," by Manly and Powell, are so pertinent that they will be quoted here.

The making of a good index is far more technical and difficult than many authors suppose. The success of a book may be said often to depend upon its index; certainly the proper use of the book does. Unless the author is familiar with the elementary requirements of a good index it is often desirable, if the book is technical or complicated, to have the index compiled by one who makes a business of this sort of work. . . . . Superficial indexing may cause a failure to use the book in the belief that it does not cover the subject, though all the while information may be there, though undisclosed by the index.

An English writer, W. C. Cocking, in his book "Steel Frame Structures," designates formulas by giving to each the number of the page on which it first occurs together with a distinctive letter. Thus any reference throughout the book to Formula (36B) indicates that it may be found for the first time on page 36, the second formula on that page. Bishop in his "Structural Drafting and the Design of Details" gives to each figure the same number as the page upon which it may be found. When more than one figure is found upon the same page they are lettered, thus: Fig. 268 (a) and Fig. 268 (b) are both on page 268.

Molitor, in his "Kinetic Theory of Engineering Structures," uses the number of the chapter instead of that of the page. Thus, Equation (15M) is found for the first time in Chapter 15. Whether these unique ways are to be preferred to numbering the formulas consecutively is not assured, but they make for easy reference.

A table at the beginning of a book of the notation and symbols used therein is always a help to the busy reader. Many textbooks have such a table.

It would be a great convenience if technical writers could agree on a standard notation for engineering symbols. Efforts to this end have been made but with only partial success. A committee of the Society for the Promotion of Engineering Education presented in 1917 a list of proposed symbols for mechanics and hydraulics. Their list has accomplished but little as yet in remedying the present chaotic condition that exists regarding the use of symbols. The present writer suggests that the compilers of the Bethlehem, Cambria, Carnegie, Jones & Laughlin, Lackawanna and Phoenix handbooks come to an agreement as to what engineering symbols they shall use in their respective publications. This would be a big step toward a uniform notation.

In conclusion, a technical book can be brought out in so attractive a makeup in the way of binding, good paper and typographical excellence that a dull or difficult subject may appear inviting. If in addition to a good external appearance the subject matter is worth presenting, the author's style is clear, the topical arrangement easy to follow, and the book well indexed, we have the requisites of an ideal book.

International Journal of Public Health

Among the original papers in the first number of the *International Journal of Public Health* (League of Red Cross Societies, Geneva, Switzerland) is one by Prof. George C. Whipple, Harvard University, on "World Sanitation: A Twentieth Century Possibility." Many

abstracts of articles already published are given. The *Journal* will appear every two months in English, French, Italian and Spanish and doubtless will contribute largely to health and sanitation throughout the world. The League also publishes a *Bulletin*, designed for laymen, the *Journal* being for professional workers. The first three numbers of the *Journal* will be sent gratis to any organization or person interested, but beginning with January, 1921, a subscription will be charged—20s.; $5; 25 francs; 25 lire, per year.

British and American Housing Problems

THE HOUSING PROBLEM: Its History, Growth, Legislation and Procedure—By John J. Clarke, M.A., F.S.S., Accountant of the University of Liverpool; Lundie Medallist for Citizenship, etc.; with an Introduction by Brig.-General G. Kyffin-Taylor, C.B.E., V.D. New York and London: Sir Isaac Pitman & Sons, Ltd. Cloth; 6 x 9 in.; pp. 544. 21/-net.

THE JOKE ABOUT HOUSING—By Charles Harris Whitaker. Boston, Mass.: Marshall Jones Co. Cloth; 6 x 9 in.; pp. 233. $2.

Mr. Clarke has produced a monograph on municipal and state housing in England. Mr. Whitaker has written a propagandist essay in which he urges that there is a housing crisis in the United States, ascribes a cause and prescribes and urges a remedy.

Of the English treatise it need only be said further that it is an exhaustive analytical and critical review of the history and present status of the British housing problem, both urban and rural, including Parliamentary Acts well into 1919, and their administration; various municipal housing enterprises, and the manifold sociological and economic aspects of the subject, with much stress on the inability of wage earners, even with recent increases in wages, to pay economic rent. The financial aspects of the subject, and rural as well as urban housing, are considered.

The joke in "The Joke About Housing," according to the publishers' statement on the jacket of the book, is that the more houses we have built in this country the smaller both they and their rooms have become, while all the time costs and rents have increased. Why? Because of land speculation, the author repeatedly asserts. One suspects him of being a single taxer, but the term "single tax" is not once used, although taxing or taking the unearned increment for the benefit of the community instead of letting it go to "non-producers" is urged again and again. The author does point his finger more than once to what he considers another large factor in the American housing problem —too small wages to pay the rent demanded for such homes as wage earners should have.

Appended to Mr. Whitaker's book are two prize essays resulting from a competition held in 1917 by the Journal of the American Institute of Architects and the Ladies' Home Journal. The prize winners were Milo Hastings and Robert Anderson Pope.

Mr. Clarke's book will repay study by the many earnest men and women who are now devoting themselves to the housing problem in America. Mr. Whitaker's volume promises to awaken many to the fact that we have a housing problem this side of the Atlantic that demands immediate and careful attention, but it has the weaknesses of books that attack many-sided problems from one side only. Nevertheless, its diagnosis of our own housing problem and the remedy it urges deserve thoughtful attention, especially by those who are engaged in establishing new industrial towns, where the unearned increment created by the community may be conserved for the creators.

Principles and Practice of Land Drainage

DRAINAGE ENGINEERING—By Daniel William Murphy, A.B., A.M., Ph.D., Consulting Engineer, M. Am. Soc. C. E., Former Drainage Engineer, United States Reclamation Service. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in. pp. 178; illustrated. $2.50.

In remarkably small space the author has presented the fundamental principles of agricultural land drainage and outlined the design and construction of drainage works. Economic and administrative phases of the subject are also summarized. Throughout the book the special problems of drainage associated with irrigation are given careful consideration. This is fitting because of the magnitude of recent and future drainage operations in connection with irrigated lands and also because the author is particularly well qualified to deal with drainage in relation to irrigation through having been drainage engineer to the United States Reclamation Service.

The author first takes up soils and plant growth, and soil, ground and surface waters. The fundamental factors in drainage and the benefits of drainage are next presented. Then comes a chapter on drainage investigations, after which the location, depth and capacity of drains are considered. Some forty-five pages are given to drainage surveys, plans, construction and maintenance. The final chapter deals with the economics of the subject, with brief consideration of drainage organization and the apportionment of drainage costs.

Most of the book is well within the understanding of any one of average intelligence, but there is enough in the way of formulas, tables and logarithmic diagrams to satisfy those who wish such things to be represented but are willing to go to treatises on hydraulics and to handbooks for detailed material of the sort. As a fresh review of an old field the volume is highly commendable.

A Highway Handbook

HIGHWAYS GREEN BOOK, 1920—Washington, D. C.: American Automobile Association. Cloth; 6 x 9 in.; pp. 525; illustrated. $3.

A veritable handbook for highway engineers, commissioners, or any one either mildly or intensely interested in road construction and the use of the automobile, is the Highways Green Book for 1920, published by the American Automobile Association. This volume divides into three parts, the first containing information relative to road improvement under Federal, state and local control. A preface to Part I supplies information upon highway legislation in the United States, and historical sketches of different bureaus for the administration of Federal funds for highway construction. Most of Part I is taken up with a detailed account of highway management and financing in the various states, each state in the United States, and also the Canadian provincial highway departments, receiving separate attention.

Part II has to do with highway construction and maintenance. Some excellent articles are reproduced explaining standard methods used in the construction of not only the so-called durable types of pavement, but also earth and sand-clay roads, gravel roads, and water-bound macadam roads.

Miscellaneous information is given in Part III, including tables of highway expenditures and mileage in the United States during the last few years, production and value of road materials, weights and measures of stone, gravel, and sand, and other valuable informa-

tion. The use of convict labor for road work has a chapter, and another is devoted to state good roads associations. Highway engineering education is taken up at length and a syllabus indicates to what extent the various colleges, universities and technical schools of the country have gone in the matter of highway engineering education. Also included in this miscellaneous information is a valuable bibliography of roads and allied subjects, and the names and addresses of highway contractors of various states. The book is issued as an annual by the Good Roads Board of the American Automobile Association, of which George C. Diehl, Buffalo, N. Y., is the chairman. It was edited by M. O. Eldridge, of Washington, D. C., the director of roads, A. A. A., who for 25 years was connected with the good roads activities of the Federal Government. The book has not only a wide popular appeal, but also a technical one.

New England Toll Roads Described

THE TURNPIKES OF NEW ENGLAND: Evolution of the Same Through England, Virginia, and Maryland—By Frederic J. Wood, M. Am. Soc. C. E., etc. Boston, Mass.: Marshall Jones Co. Cloth; 8 x 11 in.; pp. 461; illustrated. $10.

After ten years of painstaking research Mr. Wood has produced a notable volume describing in considerable detail the numerous turnpikes or toll roads of the six New England states. The volume is prefaced by an interesting and informing review of turnpikes in England, Virginia, Maryland and Pennsylvania, as well as an account of some of the roadbuilding efforts of the Federal government in the early part of the 19th century. This review also describes New England roads of the Colonial period, early road surveys and construction methods, including plank roads, and the vehicles that used the first turnpikes. There is also a short section, entitled "The First Public-Service Corporation" which describes the first American turnpike franchises or charters granted by the various legislatures. Numerous halftone views add to the handsome makeup of the volume.

Throughout the volume the author pays particular attention to the financial results of the various turnpike companies. The balances were on the wrong side of the ledger. As this soon must have been evident the author concludes that one of the governing reasons for the organization of so many turnpike companies was the general benefits they were expected to confer on the communities served.

A short section at the close of the book, entitled "Ending as It Began," states that in Virginia, within the last few years, some of the counties have reverted to the use of toll roads to collect funds in aid of maintenance. Thus, to quote from the book, there has been a return to "A two-and-a-half-century-old precedent established by Charles II when, after providing that a road should first be put in thorough repair, he authorized the erection of toll gates across it by which it was hoped to collect from those using the road the cost of maintaning it."

Such a book must be very largely a labor of love, since at best the sales can produce but a limited return to the author compared with the time and money that he must have spent in gathering and preparing his material for publication. But this does not detract from the value of such books. Indeed it is often the best testimony to their high character.

Conservation and Use of Water

WATER RESOURCES: Present and Future Uses—By Frederick Haynes Newell, Professor of Civil Engineering, University of Illinois. A Revision of the Addresses Delivered in the Chester S. Lyman Lecture Series, 1913, Before the Senior Class of the Sheffield Scientific School, Yale University. New Haven, Conn.: Yale University Press. London: Oxford University Press. Cloth; 7 x 10 in.; pp. 310; illustrated. $4.50.

While Professor Newell was still at the head of the United States Reclamation Service, he addressed the Yale Scientific School under the Lyman Fund for lectures on Water Storage Conservation. That was in 1913. Those lectures were made the basis of a volume the preparation of which was postponed by the war. The work has since been completed, "a new setting being given to it," the author states in his preface, "by the conditions which had developed" meanwhile.

The author first briefly discusses research, reconstruction, conservation, hydro-economics, economics and both engineering and broader relations. He then takes up water, precipitation, evaporation, run-in, run-off, storage, dams in general, and reclamation service dams in particular. At this point there is a change in plan, in that five main "uses of water" are considered. These are for (1) support of life, or domestic and city water supply; (2) food production, or irrigation and drainage, under which the investigations and the construction and maintenance work of the Reclamation Service are gone into; (4) water power and navigation; (5) regulation for flood prevention and protection of fish, etc. A final chapter deals with legal and legislative problems.

The treatment throughout is non-technical. A large part of the text and nearly if not quite all of the many handsome illustrations relate to irrigation—confined to studies and works of the U. S. Reclamation Service. This is natural but does not make for balanced treatment needed to justify so broad a title as the book bears. For instance, although the author states that the most extensive use of water is for city supply, his section on this subject is very brief and general. The most novel feature of the volume is a distinct recognition of the use of water for sewage disposal by dilution as legitimate. The book abounds with sound and useful suggestions.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

ACCOUNTS IN THEORY AND PRACTICE: Principles—By Earl A. Saliers, Ph.D., Assistant Professor of Accounting in the Sheffield Scientific School of Yale University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 301. $3.

Written for "a first course in the principles of accounts," primarily for first semester work but with the hope of wider usefulness. In six parts, each of "about the proper length for review and examination purposes." An appendix contains questions on each chapter. The parts deal with principles, partnerships, expansion of accounting records, corporations, financial statements and special application of principles.

ANALYSIS OF PAINT VEHICLES, JAPANS AND VARNISHES—By Clifford Dyer Holley, M.S., Ph.D., Professor Chemical Engineering, University of Michigan and Chief Chemist, Acme White Lead & Color Works. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 203; illustrated. $2.50 postpaid (13s. 6d. net).

BIRTH STATISTICS: The Birth Registration Area of the United States, 1918. Washington, D. C.: Bureau of Census. Paper; 9 x 12 in.; pp. 312. 40c. from Superintendent of Documents.

BULLETIN OF THE NATIONAL RESEARCH COUNCIL: Research Laboratories in Industrial Establishments of the United States of America. Compiled by Alfred D. Flinn, Sec., Engineering Foundation, Assisted by A. J. Porskievies, Member American Institute of Electrical Engineers and Ruth Cobb, National Research Council. Washington, D. C.: The National Research Council of the National Academy of Sciences. Paper; 7 x 10 in.; pp. 126.

Alphabetical list of 297 laboratories which by liberal interpretation do some research work, with nature of industry, chief of staff and number and classes of assistants, nature of research work, and "unusual equipment"; also geographical, scientific and engineering and commercial lists of the same laboratories. Federal, state, municipal and educational laboratories are not included.

THE BUSINESS MAN AND HIS BANK—By William H. Kniffin, Author of "The Practical Work of a Bank," "The Savings Bank and Its Practical Work," etc. New York and London: McGraw-Hill Book Co., Inc. 6 x 9 in.; pp. 278; illustrated. $3.

A plain exposition of banking as it concerns all who use banks whether for personal or business accounts, loans, etc. Besides explaining the various transactions between banks and their customers there are chapters on preparing statements, collections, reading bank statements, acceptances, bank examinations, the Federal Reserve Bank and foreign exchange. Useful and interesting to any one who has a bank account.

CITY MANAGERS' ASSOCIATION: Sixth Yearbook, 1920. New York: Harrison G. Otis, Secy., Tribune Bldg. Paper; 6 x 9 in.; pp. 183. 50c.

Contains reports from most of the 185 cities that have adopted the city manager plan, together with *Proceedings* of 1919 convention.

CLAY-WORKING INDUSTRIES, SILICA BRICK, AND BUILDING OPERATIONS IN THE LARGER CITIES IN 1918—By Jefferson Middleton. Washington, D. C.: United States Geological Survey. Paper; 6 x 9 in.; pp. 87.

COAL, IRON AND WAR: A Study in Industrialism Past and Future—By Edwin C. Eckel, Assoc. Am. Soc. C. E., Fellow, Geol. Soc. America, Late Major, Engrs., U. S. A. New York: Henry Holt & Co. Cloth; 6 x 9 in.; pp. 375. $3.

COAL-MINE TIMBERING: Trade and Industrial Series, No. 19. Washington, D. C.: Federal Board for Vocational Education. Paper; 6 x 9 in.; pp. 103; illustrated. 15c. from Superintendent of Documents.

COAL-MINE VENTILATION: Trade and Industrial Series No. 11. ashington, D. C.: Federal Board for Vocational Educatjon. Paper; 6 x 9 in.; pp. 63; illustrated. 10c. from Superintendent of Documents.

A COMPREHENSIVE CITY PLAN FOR EAST ST. LOUIS, ILLINOIS: Prepared for the War Civics Committee by Harland Bartholomew. City Plan Engineer. St. Louis, Mo.: The Author. Paper; 8 x 11 in.; pp. 60; illustrated.

Covers all phases of city planning except zoning, for which adequate legislation is lacking in Illinois.

DREDGING ENGINEERING—By F. Lester Simon, B.S. in C. E., Assoc. M. Am. Soc. C. E. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 182; illustrated. $2.50.

EARTH WORK AND ITS COST: A Handbook of Earth Excavation—By Halbert Powers Gillette, Editor of *Engineering and Contracting*, M. Am. Soc. C. E., American Institute of Mining Engineers, etc. Third Edition. New York and London: McGraw-Hill Book Co., Inc. Flexible cover; 5 x 7 in.; pp. 1,346; illustrated. $6.

EXPORTER'S GAZETTEER OF FOREIGN MARKETS: A Condensed Survey of the World's Markets and Industries Published for the Use of Manufacturers, Exporters, Bankers, Shipping and Allied Trades. Compiled and Edited by Lloyd R. Morris, Research Editor, the *American Exporter*. New York: Johnston Export Publishing Co. Cloth; 6 x 9 in.; pp. 766; illustrated. $10.

Contains a large mass of statistical and general descriptive matter regarding the products and commerce of the various countries of the world. Areas and populations are given. There are summaries and diagrams showing the total production of the world in various lines, as well as other world wide statistics.

HELPING MEN OWN FARMS: A Practical Discussion of Government Aid in Land Settlement—By Elwood Mead, Professor of Rural Institutions, University of California, Former Chairman, State Rivers and Water Supply Commission, Victoria, Australia. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 228; illustrated. $2.25.

INTERNATIONAL CABLE REGISTER OF THE WORLD: In Conjunction with Western Union Telegraphic Code, 1919. Compiled by International Cable Directory Co. New York and London: The Co. Cloth; 8 x 10 in.; pp. 1,404. $15.

THE LIGHTING OF PIERS AND WAREHOUSES: Information Compiled by A. L. Powell and R. E. Harrington, Lighting Service Department, Edison Lamp Works of General Electric Co. Harrison, N. J.: The Co. Paper; 6 x 9 in.; pp. 16; illustrated.

An admirable pamphlet. Takes up the reasons for adequate lighting, the general requirements of lighting, choice and size of lamps and the methods of laying out the lights on both piers and warehouses.

MASSACHUSETTS STATE DEPARTMENT OF HEALTH: Report, 1918. Boston, Mass. The Department. Cloth; 6 x 9 in.; pp. 260.

MATHEMATICS FOR ENGINEERS, PART II—By W. N. Rose, B.Sc. Eng. (London), Late Lecturer in Engineering Mathematics at the University of London, Goldsmiths' College, Teacher of Mathematics, Borough Polytechnic Institute. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 419; illustrated. $7.

A METALLOGRAPHIC STUDY ON TUNGSTEN STEELS—By Axel Hultgren, Metallurgical Engineer. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 133; illustrated. $3.

Based mainly on investigations at the Institute of Technology, Charlottenburg, Germany, in 1913-14. The studies were completed in 1914-18 at the Royal Institute for Testing Materials, Stockholm, and in the laboratory of the SKF Ball Bearing Co., Gothenburg, Sweden. The original paper was written in Swedish in 1918. The translation is supplemented by information subsequently brought to the attention of the author.

MINNESOTA STATE DRAINAGE LAWS: Arranged and Annotated Under the Direction of Clifford L. Hilton, Attorney General; Assisted by Commissioner of Drainage and Waters and Frank L. Cliff of the Big Stone County Bar. St. Paul, Minn.: The Attorney General. Paper; 6 x 9 in.; pp. 209.

NATIONAL DRAINAGE CONGRESS: Proceedings, 1919. Chicago, Ill.: Edmund T. Perkins, Pres. Paper; 6 x 9 in.; pp. 2[illegible].

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION: Report, 1920, to the Governor and Legislature of the State of N. Y. Albany, N. Y.: The Commission. Cloth; 9 x 12 in. pp. 82; illustrated.

OFFICERS, BOARDS, AND COMMISSIONS OF TEXAS—By Frank Mann Stewart, Instructor in Government, Secretary, Bureau of Government Research. University of Texas Bulletin No. 1854. Austin, Texas: The University. Paper; 6 x 9 in. pp. 66; folding diagram.

PERSONNEL ADMINISTRATION: Its Principles and Practice—By Ordway Tead and Henry C. Metcalf, Ph.D., Members of the Bureau of Industrial Research, N. Y. C. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 538. $5.

RAILROAD CURVES AND EARTHWORK—By C. Frank Allen, S.B., M. Am. Soc. C. E., Professor of Railroad Engineering in the Massachusetts Institute of Technology. Sixth Edition, Revised. New York and London: McGraw-Hill Book Co., Inc. Flexible Leather; 5 x 7 in.; pp. 289; illustrated. $4.

The section on circular arcs, "which received original treatment in the 1914 edition, has been enlarged to make the book still more useful in highway work. Some earthwork computation methods "new to textbooks, from valuation practice," have been added, together with a few pages on haul. Other revisions have been made. Earlier editions were reviewed in this section of *Engineering News* for Nov. 12, 1903; April 16, 1914.

RESULTS OF MAGNETIC OBSERVATIONS: Made by the United States Coast and Geodetic Survey in 1919—By Daniel L. Hazard, Assistant Chief, Division of Terrestrial Magnetism. Washington, D. C.: U. S. Coast and Geodetic Survey. Paper; 6 x 9 in. pp. 27. 5c. from Superintendent of Documents.

THE SELECTION AND PLACEMENT OF EMPLOYEES: Employment Management Series, No. 2. Washington, D. C.: Federal Board for Vocational Education. Paper; 6 x 9 in.; pp. 84; illustrated.

SHOP PRACTICE FOR HOME MECHANICS: Use of Tools, Shop Processes, Construction of Small Machines; Contains a Chapter Also on Theoretical Mechanics and on Miscellaneous Information Relative to Shop Work—By Raymond Francis Yates, Author of "Model Making," "How to Make and Use a Small Chemical Laboratory," etc. New York: The Norman W. Henley Publishing Co. Cloth; 6 x 9 in.; pp. 320; illustrated. $3.

SOME APPLICATIONS OF THE PITOT TUBE IN WATER-WORKS—By William M. Crowe, Assistant Engineer, Bureau of Water, Philadelphia, Pa. Reprint from *Fire and Water Engineering*, Sept., Oct., and Nov., 1919, issues. Philadelphia, Pa.: Simplex Valve & Meter Co. Paper; 6 x 9 in.; pp. 31; illustrated.

THE STANDARD ELECTRICAL DICTIONARY: A Complete Manual of the Science in Two Parts—By T. O'Connor Sloane, A.M., E.M., Ph.D. Author of "Arithmetic of Electricity," etc. with Addition by Prof. A. E. Watson of Brown University. 1920 Edition, Revised and Enlarged. New York: The Norman W. Henley Publishing Co. Cloth; 5 x 7 in.; pp. 767; illustrated. $5.

Apparently the changes in this edition consist in the addition of "a second part" (185 pp.) "containing all the newer developments." This necessitates looking in two places to make sure of any reference besides compelling the owner of the previous edition to buy what he already possesses without the advantage of having the new matter inserted in its proper place. But presumably had this plan not been followed a considerable higher price for the book would have been necessary.

THE STATISTICAL METHOD IN PROBLEMS OF WATER SUPPLY QUALITY—By Abel Wolman, Maryland State Department of Health. Reprinted from Quarterly Publications of the American Statistical Association, June, 1920. Baltimore, Md.: The Author. Paper; 6 x 9 in.; pp. 14.

STRUCTURAL STEEL: Australian Standard Specification. Melbourne, Australia: Institute of Science and Industry. Paper; 6 x 9 in.; pp. 19; illustrated.

STRUCTURAL STEEL WORK: Relating Principally to the Construction of Steel-Framed Buildings—By Ernest G. Beck, Wh. Ex., Assoc. M. Inst. C. E. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 462; illustrated. $7.50.

TIMBER DEPLETION, LUMBER PRICES, LUMBER EXPORTS, AND CONCENTRATION OF TIMBER OWNERSHIP: Report on Senate Resolution 311 by the Forest Service, U. S. Department of Agriculture. Washington, D. C.: The Department. Paper; 9 x 12 in.; pp. 71; illustrated. 25c. from Superintendent of Documents.

VOCATIONAL ARITHMETIC—By Clarence E. Paddock, Wentworth Institute, Boston, Mass., and Edward E. Holton, Head of Dept. of Machine Shop Practice, Technical High School, Springfield, Mass. New York and London: D. Appleton & Co. Cloth; 5 x 7 in.; pp. 232; illustrated. $2.

For students in vocational schools and men in shops. The preface says: "The usual branches of arithmetic are treated in a simple way, and the large number of practical problems gives opportunity for much exercise and option. The problems have been carefully selected and will be found interesting and useful to persons of varied interests, and to this end are presented applications to several vocations, as shop work, carpentry, foundry work, masonry, and excavation.

YALE ENGINEERING ASSOCIATION: Year Book, Including a Record of Association Affairs from the Annual Meeting of Jan. 23, 1919 to the Annul Meeting of Jan. 21, 1920 Inclusive. New York: Office of the Secretary, Third Ave. at 130th St. Paper; 6 x 9 in.; pp. 127.

LETTERS TO THE EDITOR

Rigid Joint Analysis in Concrete Frames

Sir—With the editorial in your issue of July 15, p. 97, on the simplification of reinforced-concrete design the writer is heartily in accord. But might it not be well to add that, in the pursuit of ultra-refinement in stirrup spacing, large secondary stresses often receive less attention than they should? A concrete building is, after all, a more or less indeterminate structure, and large bending moments are undoubtedly thrown into the supports of so-called simply supported members.

Take the case of a large beam framing into an exterior column. The writer has found considerable variation in the practice of different designers in computing the bending moment in the column. Some ignore it entirely. Another assumes that 80 per cent of the load is applied at the interior face of the column. The best practice seems to say "We know from experience that our standard section column for that span won't show any cracks"—perhaps a safe, but hardly a rational method. On the other hand, if the method of slope deflections is used on the assumption of a perfectly rigid joint the bending moments found would endanger most existing buildings.

The writer and doubtless other engineers would be exceedingly glad to know of tests showing actual moments found in exterior columns supporting large girders.

HENRY WILLCOX,
Construction Engineer, Kalmus, Comstock & Wescott, Inc.
New York City.

Comparisons of Paving Costs

Sir—In an article on "Paving Cost Comparison" in *Engineering News-Record* of July 8, p. 76, the city of Washington, D. C., is listed with a cost of $6.26 per square yard for asphalt paving. We would appreciate information as to how this cost is arrived at. To the best of our knowledge and belief it is not a true cost, in fact it is excessively high.

Washington, D. C. CRANFORD PAVING CO.

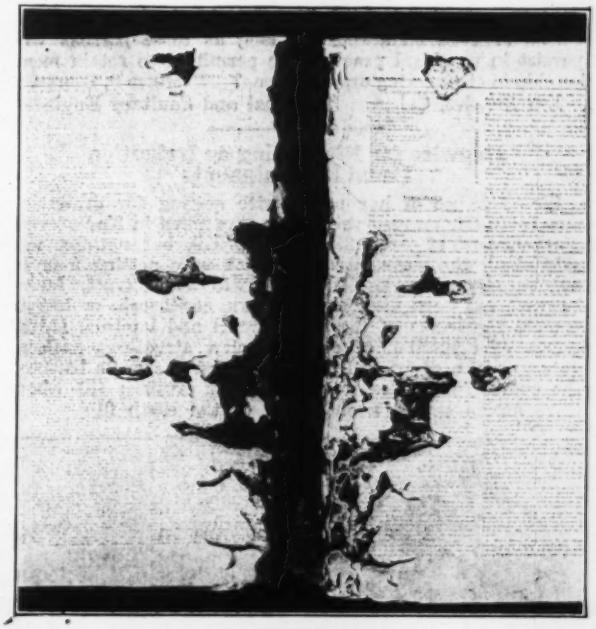
The explanation is in the basis upon which the figures were compiled. It appears that tthe Chicago Board of Local Improvements attempted to make a comparison on the square-yard basis of completed pravement including grading, concrete base, top and binder, and curbing. The figures of $6.26 for Washington and $4.15 for Chicago were obtained on an assumption of a standard 30-ft. roadway and an average 12-in. depth of grading, which would make one-third cubic yard of grading for every square yard, and three-fifths of a foot of curb per square yard. Figures obtained showed that for top and binder only the city of Washington was paying $2.96 per square yard, and for granite curbing $2.50 per lin.ft. In the absence of data on grading or concrete it was assumed that the prices would be practically the same as those prevailing in Chicago, and the original table shows that these items were estimated under those conditions. The comparisons of Chicago and Washington would be as follows:

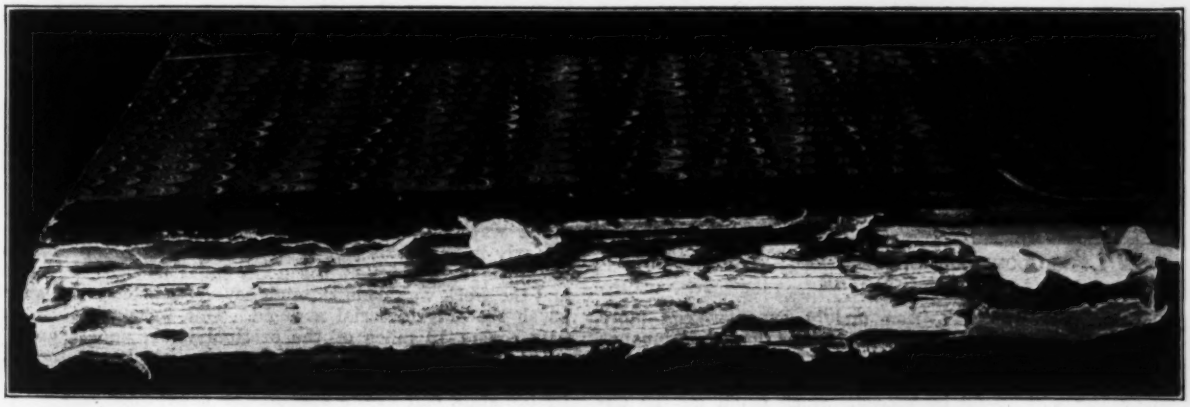
	Chicago	Washington
Grading per sq.yd.	$0.60	$0.60 (assumed)
Base per sq.yd.	.....	1.20 (assumed)
Top and binder per sq.yd.	2.88	2.96
Curb per sq.yd. pavement	0.67	1.50
Total	$4.15	$6.26

—EDITOR.

White Ants Avenge Exposure of Methods

Sir—You may be interested in the photographs which I am enclosing showing damage by termites or white ants to a bound volume of *Engineering News-Record*. This bound





HOW WHITE ANTS DAMAGED BOUND VOLUME OF "ENGINEERING NEWS-RECORD"

copy was recently found ruined in a library in an infested building in Pittsylvania County, Va.

Possibly this damage was done in revenge for the exposure of their methods in the June 3 issue of *Engineering News-Record*, p. 11[illegible].

T. E. SNYDER,
Washington, D. C. Acting Forest Entomologist,
U. S. Department of Agriculture.

City Engineers and Private Work

Sir—The charter of one of our large and growing municipalities provides that the city engineer shall do all the work for the Department of Public Works and shall devote his entire time to the duties of his office. He is employed to serve only the public, yet a very small portion of his time, for which the people pay, is used legitimately. This engineer solicits and gets other work, the doing of which is approved by the Mayor! The case of this city engineer violating all ethical codes is not an exceptional one. It is merely illustrative of conditions in many parts of the country where full-time-pay engineers indulge in putting over outside work, in contravention of their moral and official duties. The practice is not only unethical but it brings hardships to engineers who have to pay their own overhead and other expenses and who are compelled to compete with these city engineers for private work.

One of the objects of engineers as a body is to maintain a high professional standard. Can this high standard be raised or even maintained so long as those persons who persist in unethical practice are permitted to retain membership in engineering organizations? EDMUND P. BURKE.

Los Angeles, Cal. Municipal and Sanitary Engineer.

Hogwire for Riprapping on Irrigation Canal Embankments

Sir—The use of hay under wire netting for protecting new earth fills on reservoir slopes was noted in *Engineering News-Record* of Aug. 28, 1919, p. 378, but nothing was said about the varied uses to which wire netting may be put in riprap work. On the Twin Falls tract, Idaho, hogwire has been used over willows, sagebrush, or hay to protect the banks of the main canals and laterals, (1) at points of transition of current below structures such as gates, checks, drops and flumes; (2) on the made bank on the outside of curves to stop current erosion; (3) where wave action causes a sloughing of the earth fills.

FIG. 1. WILLOW "UPHOLSTERING" HELD IN PLACE BY HOGWIRE

Rock for riprap has been unduly expensive on more than one tract upon which the writer has done maintenance work. On one project hogwire was placed over willows on an eroded canal bank on account of the rapidity with which the wire could be placed. Rock could not be obtained quickly as the haul was excessive. Willows which grew on the adjoining bank, trailing the small limbs in the water and thus retarding the current, were cut for the work. They were wired into one-man-size bundles for ease in loading, hauled to the place needing protection and unloaded onto the slope with the small ends down. The bundles were broken and the willows spread to give a mat thickness of about 3 in. The willows were not spaced regularly but any large openings in the mat were closed with

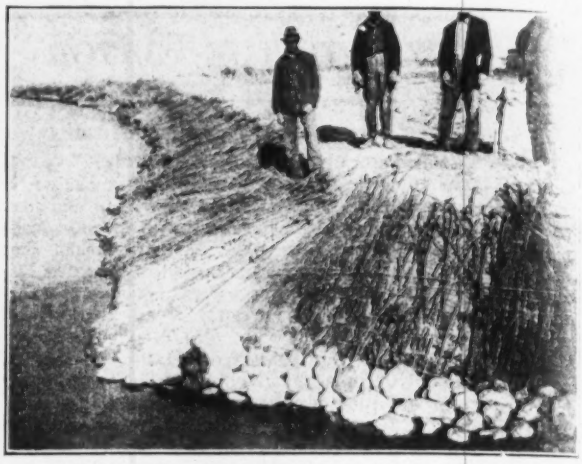


FIG. 2. UNWIRED SAGEBRUSH RIPRAP PULLED OUT BY ICE

a handful or two of the smaller branches. Hogwire in double-width strips was then unrolled over the mat. Across the hogwire ⅜-in. twisted reinforcing rods were spaced 10 to 20 ft. c. to c. and secured by pins 2-ft. long of the twisted bars with hook ends. The pins were driven carefully so as to revolve with the spiral of the metal until the head hooked over the transverse rod. The outside and middle pin also hooked over the heavy edge-strand of the hogwire.

Four men and a team could lay a half-mile of this "upholstering" in a ten-hour day when the willows were cut and left on the banks near the place to be protected. The cutting was usually done by men in the operation force, who did not handle the brush. The cost was a little less than $5 a rod. Rock work would have cost from $25 to $50, depending on th source of the rock.

In the accompanying view, Fig. 1, the outside of a curve in a canal carrying 1,400 sec.ft. in the heavy-draft season is shown "upholstered" just before the winter flow ended and the maximum flow was turned in. After 2½ months tules growing up through the riprap wire were plainly visible. Where tules grow silt is being deposited The bank shown was built up to a depth of 4 in. by the silt deposited during the high-water of the season. In another year the building-up process will be more than doubly marked, in spite of the fact that this canal bank is made of the volcanic ash soil of the Snake River Valley, which is as fine as flour.

A tube was devised to hold the pins in such a way that they could be driven accurately from a raft when the water was too deep to do the work on the bank afoot. After the water was lowered in the fall it was found that the work, while not so smooth, was fully as effective as the work done in the dry. The cost was doubled, however, due principally to the slowness of the labor working from the rafts. Only urgent necessity would prompt the use of this form of protection when it must be laid under water.

Early in the history of the project it was found that the banks on both sides of the main canal needed protection, and the work was done through several seasons, with sagebrush the only material at hand. This form of protection now covers 10 miles of the original bank, and is an admirable protection as long as the ice of the winter run does not pull it from its position. The brush was imbedded by the stalk end in the mud of the bank; rock was placed upon it in thin layers, the brush of the top of the plant forming the cushion upon which the water impinged. Of late years the high stage of the winter flow permitted ice to freeze to the upper part of the riprap where the weight of the confining material was small. The result of subsequent lower stages has invariably pulled out and floated away large sections of this valuable work. The ice was especially destructive in 1918 and 1919 because the frost was going out of the banks at the time that the water

s fluctuating in the canal. Hogwire riprap does not pull t with the ice, nor do the aquatic growths which catch on it go with the ice. Rather the wire holds the ice hen the water goes down and the ice melts on the bank here it forms, leaving the work intact.

Where "moss" aquatic vegetation in a canal exists it s entirely possible to restore banks not too much caved by placing the wire to conform to the original slope of he bank, covering it with netting, and then raising the tage of the water so that the "moss" and drift catch on he netting to form a mat under which silt will catch and deposit. The bank can often be brought to the original lope and held there until permanent settlement takes place.

R. M. ADAMS,
Superintendent Maintenance, Twin Falls Canal Co.
Twin Falls, Idaho.

Experience Shows Shinkage of Earthwork

Sir—The conclusions stated in the letter, "Shrinkage of Loosely Filled Earthwork in Embankments," by Charles Prelini (*Engineering News-Record*, July 15, 1920, p. 135), "1st. That earth in embankments will always be found of larger volume than in cuts. 2nd. That the earth does not shrink," does not accord with our experience in the construction of the Yale "Bowl."

This structure consists of an earth embankment surrounding an oval playing field, 500 ft. x 300 ft., the inner slope of which is faced with concrete and wood, in steps, and forms the support for the spectator's seats. The embankment is pierced with thirty tunnels which provide entrances to the amphitheater at the center of the slope; two other tunnels lead directly to the playing field.

The embankment was mostly formed from material scraped from the enclosed area, the top of the embankment being about 26 ft. above and the playing field about 27½ ft. below the general surface of the ground. The material was clean sand and gravel—the surface loam being saved for top dressing the field—varying in size from that which would pass a 100-mesh sieve to cobbles three or four inches in diameter; probably 80 per cent of the whole was of a grade suitable for mortar sand.

Below the level of the top of the tunnels the only compacting which the material received was that obtained by a thorough watering, as it was being deposited, and by the tamping received from teams driven over it in making the fill. Above the tunnels, the material was placed by drag line scrapers in ridges extending across the embankment, then leveled off into layers about six inches in thickness, sprinkled with water and rolled with horse drawn rollers; a smooth and a grooved roller each passing, alternately, four times over each layer.

The volume of the excavation and embankment were both carefully measured, and, as nearly all of the material was obtained from within the enclosure, and the small remaining portion from the field immediately outside, with an average haul of not more than one hundred feet, the loss by transportation was negligible. A comparison of the volume of the excavation and embankment, allowing for the sand used in concrete, showed that the former exceeded the latter nearly 7 per cent.

There was a wide difference of opinion among the engineers connected with the work as to the amount of shrinkage which would subsequently take place in the embankment and the writer was therefore curious to ascertain what it was. Consequently thirty-one bench marks were established around the rim of the "Bowl." These consisted of ½ in. rods, about 4 ft. in length, set vertically in the embankment, the lower end embedded in a lump of concrete and the upper end terminating about six inches below the surface. Levels taken on these points showed an average settlement of about one-quarter of an inch after two years; the maximum of any bench being .044 ft. Four of the points showed a settlement, after two years, of .01 ft. or less. About one-half of the settlement occurred within the first month after the embankment was completed.

If evidence, additional to our measurements, was required to show that earthwork shrinks, it was furnished by the fact that it was much more difficult to drive stakes into the embankment than it was into the same material before it was disturbed; showing that its density had been increased. These facts, I think, prove, conclusively, that earth not only shrinks during the construction of an embankment but also, that even with extreme care used in impacting the material when it is being placed, some settlement will subsequently occur.

CHARLES A. FERRY,
Engineer, Yale "Bowl."

Beams vs. Trusses for Pier Shed

Sir—In *Engineering News-Record*, June 24, 1920, p. 1232, there appeared an article describing precast concrete roof trusses used in the shed of Pier No. 6 at Cristobal, Canal Zone. The reasons for the adoption of this type of construction are not evident. It is difficult to locate any advantage over the ordinary form of beam and girder structure.

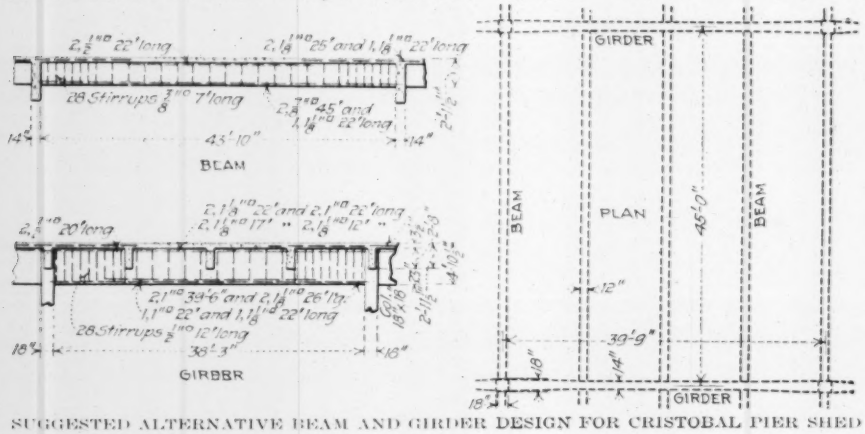
The quantities of steel and concrete in the smaller trusses compare favorably with the corresponding members of a beam and girder roof, but the steel in the heavy cross trusses seems to be excessive. Assuming a unit stress of 16,000 lb. per square inch in the steel, the bars in the tension members have an excess varying from 35 per cent to 170 per cent over the required areas, the higher excess, however, being in a minor member which would have little relative effect upon the structure as a whole. There is a large amount of steel in compression members as well as in those members at the ends which have no calculated stress. Furthermore, the bars at intersections of members and the necessary long laps of all tension bars contain a relatively large amount of steel. These facts account for a considerable portion of the total amount of steel used, yet 4,000 lb. per truss still appears to be more than would be required under any considerations. Criticism should also be permitted concerning the distance at which bars are kept from the face of concrete in many members. A safer structure would result if bars were placed closer to the corners. In one section the concrete is 20 x 10 in., while the rectangle through the centers of outer bars is 9 x 4 in.

The truss scheme results in a higher building than would be required in the case of a beam and girder roof maintaining the same clear headroom. Also the columns are heavier and of more difficult construction than would be required for a building of ordinary monolithic construction. On a complicated layout requiring many different sizes of trusses this scheme would necessitate a large form cost. Also, the truss plan results in three concreting operations for that part of building above the foundations and main floor, while the usual plan would require only one for any part of building. The trusses were cast in a plant adapted to that work only, the columns were poured separately and in place. The roof slab was cast after the trusses had been erected. Therefore the saving in time is hard to understand.

Accepting the layout of building given by the published diagram, surely the following details would show that beams and girders would prove to be more economical than are the trusses. Fig. 1 shows a partial plan, Fig. 2 is an elevation of a typical interior beam, and Fig. 3 shows an interior girder. In designing the beam $\frac{1}{12}\ wl^2$ and $\frac{1}{16}\ wl^2$ were used for negative and positive moments, respectively. In the girder the negative moment was taken as ⅛ and the positive as ¼ of the simple beam moments for the same clear span. These moments are justified by facts relative to such cases, especially since all loads are uniform and constant. And it is the writer's trust that the near future will witness the general use of such moments for ordinary building work in reinforced concrete. Furthermore, actual stresses are used in truss design and, in fairness, these moments should be used in beams designed to carry the same loads, particularly since the sum of positive and negative moments is 17 per cent greater than the total moment possible. The design unit stresses used are 16,000 lb. in the steel and 650 and 750 lb. in concrete for positive and negative bending, respectively. Concrete is assumed as taking shear at 60 lb. per

square inch over the *b'jd* section. Stirrups take the remaining shear, additional stirrups being used throughout the portion of beam having small shear. The slab is assumed the same as in truss type building. End spans of beams and girders would have somewhat greater moment. The same sections could be used and the steel increased, also using some compression steel in the bottoms at supports. Crane loads are not taken into account as they do not affect the members considered. Crane load data was not given in the article.

Each beam contains 730 lb. of steel and the stem has 4.35 cu.yd. of concrete as compared with 1,000 lb. and 3.5 cu.yd. for the corresponding truss. Each girder contains 1,520 lb. of steel and its stem has 8.1 cu.yd. of concrete. This is to be compared with 4,000 lb. of steel and 8.5 cu.yd. of concrete in the cross truss. Using the unit prices for the trusses as built and taking the slab prices as correct for beam and girder materials, the concrete and steel in each beam costs $14 more than that of the small truss while the indicated saving for each girder is $95. For the concrete and steel alone there is a net result slightly against the trusses. No figures can be given as to cost of forms as there is no available data to show probable number of times that these could be used. It would seem that there would be an advantage in the simple form details required for the beam and girder construction.



SUGGESTED ALTERNATIVE BEAM AND GIRDER DESIGN FOR CRISTOBAL PIER SHED

Besides the foregoing items, all walls and columns would be of less height in the beam and girder building, since the total depth of roof structure is 4 ft. 8 in. less than in the truss structure. Instead of the 30 in. square interior columns with complicated top forming, a section 18 in. square would be sufficient to carry the beam and girder roof and the rigid top connection would eliminate the necessity of the expanded section at base. There would be a similar saving in wall columns. The beam and girder type of building has the additional advantage of requiring simpler construction plant since no equipment would be needed other than that used for the roof slab of the truss type. The probable saving in the structure as a whole would lie principally in the 4 ft. 8 in. reduction in height of columns and walls and in the lighter sections of the former, although the beams and girders likely would cost somewhat less than the corresponding trusses. The steel prices used in comparing costs of beams with those of trusses are severe in that prices of slab steel were adopted as the only stated item that could be taken for the purpose. A smaller steel price would be just since large sizes are used in the trusses and beams, while all slab steel is under base material.

All things considered, it would seem that the beam and girder construction would have resulted in a more economical building without in any manner detracting from the value. Possibly there were some governing conditions, not stated in the article, which would cast a different light upon the subject. Also, it is possible that there were other loads besides the roof carried by the heavy trusses and of which no mention was made. If such is the case, corrections are invited.

The writer has had to resort to trusses in a few ca of unusual reinforced concrete design, but almost invaria has found ordinary beam and girder construction to be m economical for such work as that under consideration.

LEONARD C. JORDAN,
New Rochelle, N. Y. Consulting and Designing Engine

[The above letter was submitted to G. W. True, t author of the article in question and he has replied as fo lows:—EDITOR.].

Sir—Mr. Jordan's comments on the article entitled "Precast Concrete Trusses in Panama Pier Shed" might possibly be applicable on a small sized project or when a number of trusses of variable size were required. Experience on previous pier construction on the Isthmus indicated that precast concrete work would be fully as rapid a form of construction as concrete poured in place, and hence the precast beams which were originally considered were naturally superseded by the precast trusses after both had been fully investigated. The results shown on the progress charts appear to have fully justified the adoption of the precast units. Mr. Jordan states that the anticipated saving by using continuous beams would lie principally in the reduction in the height of columns and walls, as well as in the lighter section of the former. As a matter of fact, the shed was built at a minimum height and the question of raising the entire elevation was seriously considered for architectural reasons. Moreover, as the possibility of changing the structure to a two-story shed was taken into consideration, the size of the columns were increased to provide for this contingency.

The cross-trusses were originally designed for a heavier load than was eventually used. When it was shown conclusively by tests and certain experimental handling that the designing load could be modified in the smaller trusses, it was permitted, but as the greater number of cross trusses had been built when this change was made, the design of the cross trusses was not revised. Had this change been made at the beginning of the work, the amount of steel in this item would naturally have been reduced with a consequent reduction in cost for the entire project.

The original article (under "method of construction) states that each form for the longitudinal trusses was used about thirty times. It is questionable whether ordinary forms on beams could have been used as many times as this even with repairs.

The spacing of bars in section BB was determined by the clearance required by other bars at the adjacent joints and hence could not well be avoided. Since it occurs in a tension member, the spacing cannot be considered as objectionable.

It should be remembered in criticizing concrete truss design that experimental data relative to such structures is very meager and that with our present knowledge of the subject, any design which shows even a slight saving over beams should be pronounced a success. The economy effected by the concrete trusses in this work when compared with structural steel under wide variations in unit costs speaks for itself.

Thus far, there are numerous points that can be settled only by individual judgment. Obviously, a description of various details of trusses actually built and in successful use will unquestionably aid the profession to eventually standardize this class of work.

GUY W. TRUE,
Assistant Engineer, Panama Canal.
Balboa Heights, C. Z.

Crawfish Cause Trouble at a Power Plant in North Carolina

Sir—We have a wide irregular canal one mile long built long the bank of the river to convey the water from the dam to power house. About one-fourth mile below the dam we have had trouble from the start with crawfish burrowing through the bank and starting troublesome leaks. They seem to confine themselves to a space about 50 ft. long. Numerous attempts to stop their burrowing have been tried out as yet none has been successful.

Some six or eight years ago a row of 2 in. splined wood piling was driven in the center of the bank, but in a short time leaks appeared again. We have dug up the burrows on the canal side of the bank several times and puddled them over each time, but that has only proved a temporary repair. It would always stop the leak until the burrows were again opened to the forebay by the crawfish. Our last effort consisted in digging a trench 4 ft. deep, driving 9-in. steel sheet-piling 12 ft. long to cut off the leaks, but this was in only very small measure successful. We then dug down behind the piling in two places and found that after digging 8 ft. deep we could still run a small pole some 8 ft. farther straight down indicating that these crawfish burrows extended at least 16 ft. below the ground if not more and that the driving of longer piling would likely not be effective in stopping the trouble.

The water loss is not serious but frequent high water makes the leak dangerous.

The problem now reduces to some effective method of impregnating the earth of this section of the bank with some chemical, and to a depth that will kill the crawfish or that will drive them away permanently. If we can drive them away from this place we do not think they will give trouble elsewhere. We have the government bulletin on "Crawfish as Crop Destroyers" but that does not apply.

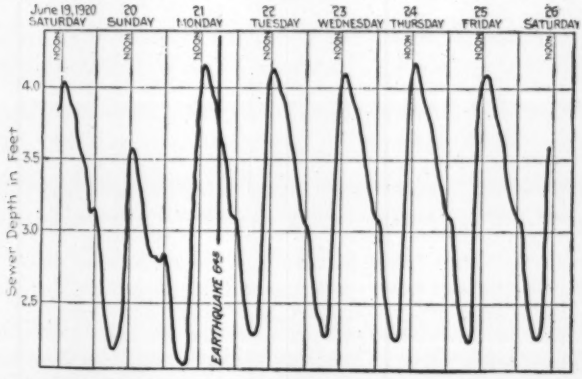
We considered plastering a portion of the canel side of the bank with concrete, but as yet we favor trying the experiment of impregnating the soil with some chemical that will be effective in either killing the fish or driving them away.

We are soliciting any information as to suitable chemicals for this experiment but any suggestion not intimated here that might prove worth trying will be most welcome.

A SUBSCRIBER.

Effect of Earthquake on Sewage-Flow Gage at Los Angeles, Cal.

Sir—The effect of the earthquake which occurred in the vicinity of Los Angeles on June 21 of this year was recorded by an automatic water register at the Inglewood gauging station on the line of the outfall sewer of this city in a manner which may prove of interest to your readers. The accompanying diagram shows quite clearly by the vertical line (June 21) how the needle at this station moved during the period in which the earthquake was noted. It is considered that probably the effect of the earthquake was to start a wave in the sewer conduit. This sewer has a vertical diameter of 73 in. and it will be noted that the average normal flow of sewage in this conduit is about at the springing line of the sewer. Just before this wave reached the gaging station, the depth of flow was about 3 ft. 9 in. and this depth was raised to about 4 ft. 4 in. when the wave reached the station. As the wave receded the flow dropped to a little less than 3 ft. showing that the vertical distance between the bottom and the crest of the wave was a little over 16 in. After reaching the low point, the needle indicated that the depth of 3 ft. 9 in. was again obtained, after which the needle resumed its customary travel.



EFFECT OF EARTHQUAKE JUNE 21 ON FLOW IN OUTFALL SEWER AT LOS ANGELES, CAL.

It is considered that probably the direction of this quake was parallel to the line of the sewer, which would tend to increase the effect at the gaging station.

The writer would be pleased to know of similar cases which have been recorded in sewers from such causes; also to answer any questions concerning matters which have not been described in the above.

JOHN A. GRIFFIN,
Los Angeles, Cal. City Engineer.
By W. T. Knowlton, Engineer of Sewers.

The Danger in Immigration

Sir—I notice occasional articles in your paper relating to immigration, labor supply, etc. In all that I have read the effect on the employment of engineers, the slowing up of public improvements, the earnings of capital, or similar viewpoints are the only ones given consideration. It seems to be taken for granted that a continually increasing population is in itself a desirable thing, even though it inevitably brings us closer to the European social and economic standard of living, and intensifies the struggle for existence that is already too keen.

Recent letters advocate the admission of Orientals and a return to the indiscriminate immigration of Southern Europe on the ground that it will help industry. Without questioning the personal worth of these people or their civilization, I believe that, regardless of our material development, further dilution of American citizenship should not be allowed or encouraged. Regardless of its economic effect on me or the country, the more unassimilated foreigners there who are to return to their old homes the better it pleases me.

It is my opinion that a mongrel race is in the same class as mongrel stock and that the melting pot is largely an illusion fostered by sentimentalists, steamship companies and big industries who hope for profit.

In the face of all the trouble we have recently had during the war with un-American sections of our population, industrial interests are clamoring for a resumption of former practice. We have one great race problem. Why should we add more as suggested by Mr. Erickson in a recent issue? I believe that the question of our employment as engineers should be secondary to the larger question of what is best for the future of the country.

By race I do not mean nationality, religion, or language, for these may cut across race lines. This country, as is pointed out by a recent writer on this subject, was peopled from the north of Europe. Its population increased with great rapidity with slight immigration until 1850, and would have continued to do so had not heavy immigration begun. Our country would have been populated and developed by a homogeneous race with no outside help if this had not occurred. The sure result of an influx of a people of lower standards of living is the lowering of the increase of the dominant type. There are countries in Europe whose population do not represent the people who made their names great in history. They live on the fame of a dead race.

For these reasons I sympathize with the people of California and Australia, and also the labor unions on the immigration question, though the latter's interest is as selfish as that of their opponents.

A man may be assimilated politically, but you cannot change his race. He either succumbs to another type when in contact with it or he overcomes it.

Civilization may be lost and regained, but a race or a species once lost, is gone forever.

Ogden, Utah. E. E. KIDDER.

HINTS FOR THE CONTRACTOR

Pontoon Pipe Line for Dredging Withstands Rough Seas

EXCELLENT service in rough seas was given by the pontoon pipe line illustrated in dredging a ship channel 200 ft. wide and 15½ mi. long in the exposed waters of Atchafalaya Bay on the Gulf of Mexico. The pontoons were steel and 47 x 12 ft. x 2 ft. 10 in., and each carried a 50-ft. length of pipe on a turntable at the middle of the pontoon. The pipe line was carried straight out at right angles to the side of the dredge

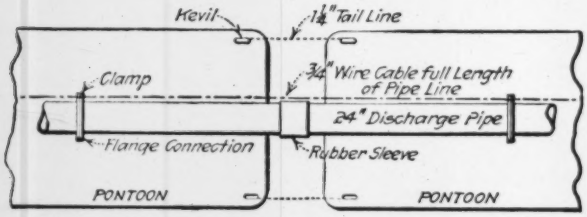


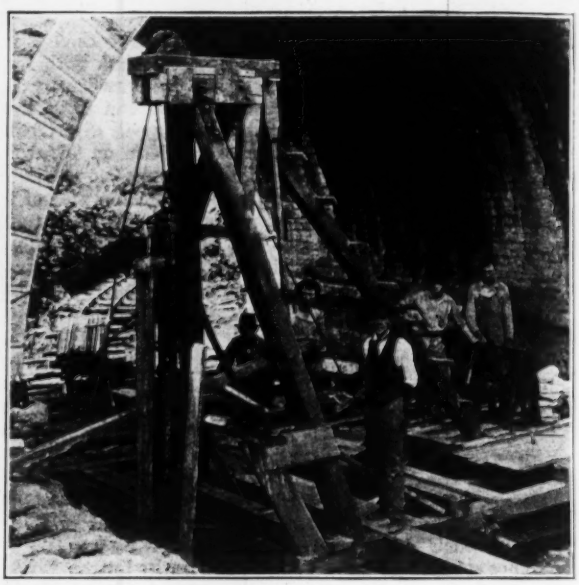
DIAGRAM OF PONTOON AND PIPE CONNECTIONS FOR SPECIAL SERVICE

and held in line by a cable extending from the dredge to a pile sinker anchored outboard a distance of 100 ft. greater than the length of the pipe line, which was variable. Other construction details are indicated by the drawing. This construction, says U. S. Assistant Engineer T. E. L. Lipsey, in the *Military Engineer*, "proved to be one of the best ever seen and was capable of withstanding the most severe weather and seas."

Driving Steel Sheet Piles Without Headroom For a Piledriver

BY USING a shackle to pull down part way a second pile, as each pile was driven home, steel sheeting was successfully sunk under bridge arches where the headroom at the start did not permit the driver to be mounted on the pile tops. To construct two tailrace conduits under adjoining arches of a railway bridge, trenches nearly as wide as the spans and going 12 ft. deeper than the bridge pier footings had to be retained by 12-ft. steel pile sheeting. In starting this sheet at the surface, the tops of the piles reached nearly the soffits of the arches and a steam driver could not be mounted on them until they had been driven about 5 ft.

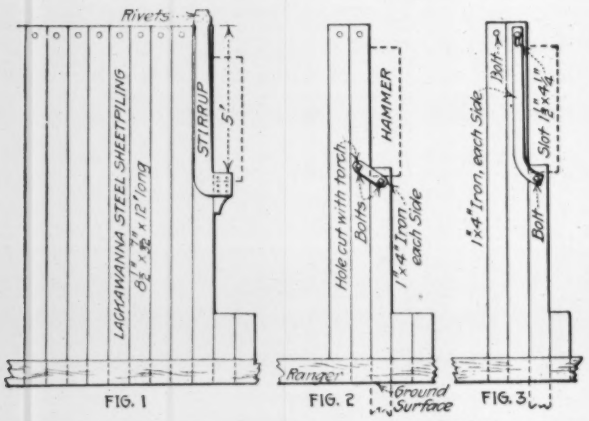
A series of experiments determined a successful method which is illustrated by the drawing. First, the attempt was made to drive the piles singly using a stirrup like that shown by Fig. 1, but with its foot on the side of the pile. Vibration of the pile made this method ineffective. Then the stirrup was changed to the form shown by Fig. 1, with better results, but the operation was very slow. A 7-ft. pile was then driven and pulled with the thought that a 12-ft. pile might be inserted in the hole and then driven, but this experiment failed because the hole caved in. Next the process shown by Fig. 2 was devised. With one pile driven about half down, using the stirrup, the hammer was



RIG FOR HANDLING HAMMER IN DRIVING SHEETING UNDER BRIDGE ARCH

set on top and a shackle attached, as shown, to the adjoining pile. Then in driving the first pile home the second was pulled down half way. The hammer was then mounted on the second pile. The idea was practicable, but the short shackle sheared out the bolt holes. A long shackle as shown in Fig. 3 remedied the trouble.

As perfected the method was to assemble on the ground a sheet of nine piles, interlocked, and up-end the sheet as a unit against the guide rangers. The first pile was driven half way using the stirrup of Fig. 1. Then the shackle shown by Fig. 3 was applied and the first pile was driven home, with the hammer on top, and the second pile pulled down half way. The hammer and shackle were then shifted and the operation repeated until all nine piles were at bottom. Another sheet of nine piles was assembled and driven and so on. By this



METHODS OF DRIVING SHEET PILES WITH HEADROOM LIMITED

...hod as many as 16 piles in 10 hr. were driven when ... ground was good. If boulders were encountered ... sometimes required hours to sink one pile.

...s shown by the view, the hammer was hung from a tripod on rollers and handled by a hand winch. A detail found useful was to mount the top pulley on a plank, which, sliding in guides, could be pushed forward and withdrawn by a lever to adjust the hang of the hammer.

The work described was performed at Hamilton, O., as a part of the operations of the Miami Conservancy District, Arthur E. Morgan, chief engineer, Charles H. Paul, assistant chief engineer, and C. H. Locher, construction engineer.

Bridge Pier Foundation Carried to Rock by Air Bell

By W. M. Ray,
Assistant Engineer, Baltimore & Ohio R.R., Pittsburgh

In the reconstruction of the Baltimore & Ohio R.R. bridge over the Allegheny River at Herr's Island, Pittsburgh, Pa., the cofferdam built for extending one of the piers leaked so seriously that open excavation became impracticable. Under the conditions an air bell was used to reach sound bottom, with entire success.

Starting from the Pittsburgh side at the foot of 33rd St., the bridge crosses the main channel of the river, Herr's Island, and the back channel to the north or Allegheny side of the city. In the back channel the location of the new bridge diverges from that of the old structure, though the latter is retained to carry a low-grade track to the island. Because of the divergence special conditions governed the construction of the piers in this part of the structure. Two piers had to be built as extensions of the corresponding old piers,

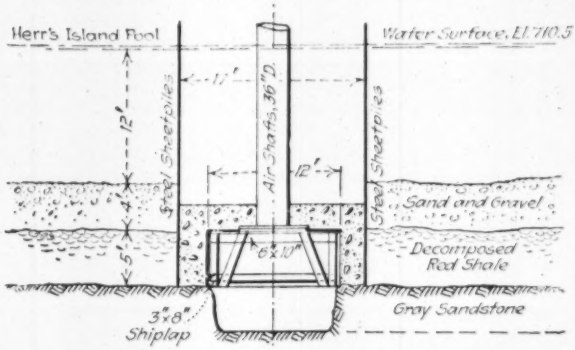


FIG. 1. CROSS-SECTION OF AIR BELL IN COFFERDAM, PIER *N* FOUNDATION. B. & O. BRIDGE, PITTSBURGH

known as Piers M and N. The principal difficulties, and those which led to the use of the air bell, occurred in case of Pier N.

Soundings at this pier showed a depth below the pool stage of 12 ft. to river bottom. The soil below consisted of 4 ft. of sand and gravel and 5 ft. of decomposed red shale overlying sandstone. As it was desired to reach the sandstone foundation the site was first dredged to a depth of 18 ft., or to within about 3 ft. of the rock, and the pier area was inclosed by a cofferdam consisting of a single row of interlocking steel sheetpiles. The inclosed area was further dredged to within 1 ft. of rock and the cofferdam wall banked on all sides with excavated material.

Attempts to pump the cofferdam developed considerable leakage, especially at the end next to the old masonry pier, where the cofferdam was joined up with the old piers by inclosed pockets filled with clay and sealed with concrete deposited by tremie against the old masonry. Previous inspection by diver had indicated that the old pier had probably been started in a floating timber box or caisson sunk on a site previously dredged to a hard bottom. As there was considerable vibration in the old pier under passing trains it was not considered advisable to continue pumping the cofferdam and thereby drawing water through and under the old footing. These considerations led to the adoption of the air-bell method for completing excavation and depositing concrete in the cofferdam. It should be said that a compressor plant and a force of foundation workers were available on account of the recent completion of three pneumatic caisson foundations in the main river channel.

The cofferdam was about 17 x 33 ft. in inside dimensions. The air bell consisted of an inverted box 12 x 48 ft., 5 ft. high, which was built on the island and hoisted into position over the cofferdam by derrick boat. After three air-shaft sections were attached the

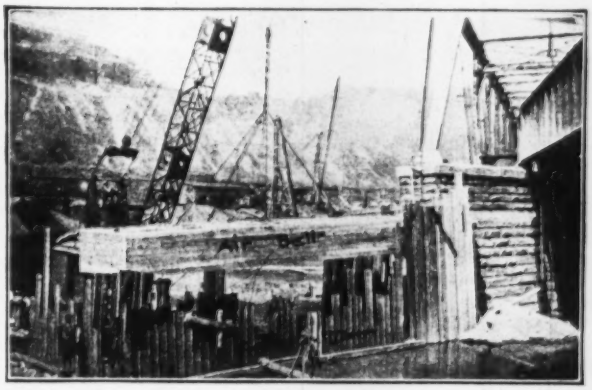


FIG. 2. DERRICK BOAT LIFTING AIR BELL INTO COFFERDAM, PIER *N* FOUNDATION

bell was sunk to bottom inside the cofferdam, leaving a space of about 2½ ft. on all sides between it and the steel sheetpiling. Concrete was then deposited by tremie around and over the bell, thus sealing the top and sides (Fig. 1), after which the cofferdam was unwatered and concrete deposited in the dry to water level.

Air pressure was then applied sufficient to unwater the bell and permit cleaning out the excavation under it. As the rock surface thus exposed was soft the excavation was carried 4 ft. into the sandstone under the area of the bell. Then the entire excavation and interior of the bell were concreted under air pressure.

The air bell was of light construction, as the conditions of its service were entirely different from those governing the construction of regular caissons for pneumatic work; there were no launching or cutting-edge stresses to be provided for and the concrete inclosing the bell was expected to counteract the interior air pressure. In this case the bell was built of 3 x 8-in. ship-lap pine sheathing spiked to nine cross-frames of 6 x 10-in. pine timber.

Under the circumstances, and with compressed-air equipment at hand, the use of the bell as described proved to be a quick and economical method.

NEWS OF THE WEEK

New York, August 19, 1920

Huge Reservoir on Colorado for Imperial Valley

Dam 600 Ft. High Would Store 25,000,000 Acre-Feet for Irrigation, Flood Protection and Power

(Conference Reported for ENGINEERING NEWS-RECORD *by J. B. Lippincott, Consulting Engineer, Los Angeles.)*

A hearing on the development of the Colorado River was held at San Diego, Cal., Aug. 3 by Arthur P. Davis, director of the U. S. Reclamation Service and president of the American Society of Civil Engineers. There were approximately 100 delegates present, including state engineers from Colorado, Arizona and Nevada, personal representatives of the governors of the various states that lie partly within the drainage basin of this stream, representatives of several irrigation districts and companies, the cities of Los Angeles and San Diego, the American Legion and others.

The problem under consideration was the impounding of the flood waters of the Colorado River for three purposes: (1) Irrigation of additional arid lands below the Grand Canyon of Colorado, both in the United States and Mexico. (2) The prevention of over-flow and flood damage caused by the high waters of that stream. (3) The generation and distribution of hydro-electric power attained in connection with these storage problems.

The hearing was held under the Kincaid Act, passed by Congress in May, 1920, entitled "An Act to Provide for an Examination and Report on the Condition and Possible Irrigation Development of the Imperial Valley in California." This act instructed the Secretary of the Interior to formulate a policy for this great enterprise, and particularly to make recommendation as to the extent to which in his opinion the United States should contribute to the cost of carrying out the plan; also the approximate proportion of the total cost which should be borne by the various irrigation districts or organizations now organized, or which may organize in the future, and the manner in which their contribution should be made.

The Kincaid Act carried an appropriation of $20,000 for further investigations of Imperial Valley irrigation possibilities, conditioned on provision for at least one-half the cost of the investigations being provided for by "associations and agencies interested in the irrigation of the lands of the Imperial Valley." The Imperial Irrigation District has made a contribution of $40,000 and the Board of Public Service of the City of Los Angeles has offered any additional funds that may be necessary for the adequate completion of the study in time for report to Congress next winter.

BORINGS BEING MADE

Borings are being made for a dam site in what is known as Boulder Canyon, a narrow granite canyon situated near the extreme southern end of the State of Nevada. If these foundations prove satisfactory, it is proposed that a dam be constructed at this point, designed for a possible maximum height of 600 ft., with a storage capacity averaging 25,000,000 acre-ft., which would be sufficient to regulate all the flood flows of the Colorado River from above that point and to provide a water supply sufficient to irrigate all lands that could be reached by gravity below it, either in the United States or Mexico.

The importance of the problem can scarcely be overestimated. All of the delegates at the hearing were in favor of a large storage reservoir on the Colorado River. Director Davis will make the necessary survey and field investigations and formulate a plan which will be presented to Congress in accordance with the Kincaid Act.

More Favorable Shipment of Road Materials Now Secured

A more sympathetic attitude toward the movement of road materials by the railroads now prevails, in the opinion of Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads. The Bureau of Public Roads is keeping in close touch with the Interstate Commerce Commission and has detailed personnel to assist the car service commission of the American Railroad Association in handling requests for cars to be used to transport materials for road maintenance and for the completion of unfinished contracts. In a letter to state highway departments Mr. MacDonald outlines in detail the steps which must be taken to secure cars. He points out that it is the desire of the Interstate Commerce Commission that the shippers and the local railroad officials co-operate to settle, in so far as is possible, their transportation problems without calling upon agencies in Washington. He also points out that ways are being found to route returning coal cars in such a manner that they can be utilized for the handling of road materials, without interfering with the order giving priority to coal cars.

Civil Engineers to Vote on Federation

At Annual Convention Decision is Reached to Submit Question to Membership in Referendum Ballot

Action taken at the annual convention of the American Society of Civil Engineers held at Portland, Ore., Aug. 10-12, indicates that an early decision will be reached, by referendum ballot to the membership, on the question of joining the Federated American Engineering Societies. The Board of Direction at first favored delay until the legal status of the proposal could be investigated, but the meeting expressed its desire for immediate action.

The following resolutions of the Board of Direction summarize the action taken with regard to the federation:

"WHEREAS, The Board of Direction at its meeting of Aug. 9, 1920, at Portland, Oregon, adopted the following: 'Moved that the secretary be authorized to secure as soon as possible legal opinion from Parker & Aaron as to whether the society can, under its charter and constitution, enter the Federated American Engineering Societies, and if not what action may be taken to secure such power; and that contingent upon favorable opinion being received there be issued immediately a referendum ballot as submitted by the Joint Conference Report to be accompanied by pro arguments prepared by Messrs. Wall, Henny and Hoyt, and con arguments prepared by Messrs. Pegram, Alvord and Tuttle, and sent out by the secretary,'

"AND WHEREAS, the Annual Convention at its meeting of Aug. 10, 1920, passed by a vote of 73 to 13 the following: 'Moved that it is the sense of this meeting, (1) that the action of the Board of Direction of the American Society of Civil Engineers relative to joining the Federated American Engineering Societies taken at the meeting of Aug. 9, 1920, should be reconsidered; and (2) that the Board of Direction of the American Society of Civil Engineers be directed to submit at once the question of the American Society of Civil Engineers becoming a charter member of the Federated American Engineering Societies to referendum vote to the corporate membership of the American Society of Civil Engineers as recommended by the Joint Conference Committee, said ballot to be accompanied by a copy of the constitution and by-laws of said federation; and (3) that the Board of Direction of the American Society of Civil Engineers be

further instructed in event of favorable vote on said referendum to proceed at once to take such steps as may be necessary for the American Society of Civil Engineers to become affiliated with said federation.' Now then be it

"RESOLVED: that without rescinding its action the Board of Direction as expressed in its resolution of Aug. 9, now further resolves that in courtesy to the desires expressed by the annual convention the secretary is hereby instructed that without waiting for legal advice he should issue to the corporate membership without delay a referendum ballot on the following question, 'Shall the American Society of Civil Engineers become a Charter Member of the Federated American Engineering Societies?', this referendum to be accompanied by arguments for to be prepared by Messrs. Wall, Henny and Hoyt, and arguments against to be prepared by Messrs. Pegram, Alvord and Tuttle, together with a copy of the constitution and by-laws of said federation and copy of this resolution, and be it

"FURTHER RESOLVED: That the president and secretary are hereby instructed to at once secure from Parker & Aaron, the society's counsel, an opinion as to whether the society has the power under its charter and constitution to enter the Federated American Engineering Societies, and whether the amendments as at present proposed will accomplish such purpose, and if not what action must be taken by the society to secure such power, and that the executive committee shall inform the corporate membership of its substance as soon as possible if this can, in the committee's judgment, be done without jeopardy to the interests of the society."

General Contractors Seek Data on Cost of Owning Equipment

The Committee on Methods of the Associated General Contractors of America has tabulated the expenses of owning various machines as percentages of the capital investment. This tabulation is given in the accompanying table, copies of which have been sent to all members of the association for criticism so that a check upon the adequacy of depreciation and repair charges may be had from men who are familiar with the practical operation of the various types of machines. The data for this table have been collected from various sources, including manufacturers of equipment.

In sending out a circular letter including this cost tabulation the secretary of the association has requested answers to various questions regarding owning equipment. It is well known that the biggest problem in determining rental charges is depreciation and repair, and these questions accompanying the tabulation refer to the average salvage value for condemned equipment, the average economical life of plant, percentage assigned by contractors to shop repairs, and the percentage allowed for field and minor repairs.

Equipment:	Economical Length of Life in Years	Annual Shop Repairs Per Cent of Capital Investment	Annual Field Repairs Per Cent of Capital Investment
Auto cranes	5	6	5
Automobile trucks	3	20	20
Automobile trailers	5	6	5
Backfiller, power	4	6	7
Ballast spreaders	8	6	4
Boilers, upright	6	25	5
Boilers, locomotive	8	16	4
Buckets, clam shell	6	6	4
Buckets, orange peel	6	7	6
Buckets, drag line	4	5	3
Cars, steel dump	8	4	3
Cars, wood dump	6	3	2
Cars, flat	8	3	3
Cars, hopper	5	3	3
Compressors, portable:			
Steam	6	5	3
Gasoline	5	6	4
Electric	6	3	3
Concrete chutes	2	10	15
Conveyor, belt	2	4	6
Conveyor, bucket	2	6	6
Crushers, rock	6	5	3
Derricks, wood	5	4	4
Derricks, steel	10	3	3
Dragline excavators:			
Steam	6	9	8
Gasoline	4	10	10
Electric	8	7	7
Drill, tunnel carriages	5	8	8
Riggs, traction well	8	5	10
Rigs, tripod	4	5	10
Rigs, jackhamer	4	4	6
Engines, gas	6	8	8
Engines, steam	10	5	5
Excavators, cableway	6	4	12
Excavators, keystone	6	6	4
Excavators, trench traction	5	8	6
Finishing machines:			
Tampers	3	10	8
Graders:			
Road	3	12	6
Elevating	4	15	7
Hammers, riveting	5	6	4
Hoists, steam	10	6	4
Hoists, gasoline	5	8	6
Hoists, electric	8	5	3
Locomotives, industrial:			
Steam	8	7	4
Locomotives, gasoline	4	10	10
Locomotives, electric battery	4	15	4
Locomotive cranes:			
Steam	8	7	8
Mixers, steam	7	6	4
Mixers, gasoline	4	8	6
Mixers, electric	7	6	4
Mixers, steam:			
Paving	7	6	4
Mixers, gasoline:			
Paving	4	10	6
Motors	6	6	4
Pile drivers, steam	6	7	5
Pile drivers, track	10	5	3
Pile hammers, steam	6	7	3
Pipe, galvanized	3		6
Plows	3	15	10
Pneumatic concrete placing	5	4	8
Machine:			
Pumps, centrifugal D.C.	8	6	4
Pumps, piston D.C.	6	7	5
Pumps, pulsometer	10	2	4
Pumps, Emerson	10	2	4
Rails	10	3	4
Rerk Channeling Machines	6	7	8
Rollers, steam road	10	4	3
Rollers, gasoline road	6	6	4
Scrapers, wheel	3	6	4
Scrapers, slip	2	25	10
Scrapers, fresno	2	25	15
Shovels, steam	6	7	6
Shovels, gasoline	4	9	7
Shovels, electric	7	6	5
Switches	3	3	3
Towers, steel elevator	4	3	4
Tractors, wheel, gasoline	6	8	5
Tractors, caterpillar, gasoline	5	15	10
Wagons, dump	4	17	3
Wagons, hauling	4	12	3
Wagon loaders, power	5	10	6

Material Handling Section Formed by Mechanical Engineers

The Material Handling Section of the American Society of Mechanical Engineers was formed at an organizing meeting held in the Engineering Societies Building, 29 West 39th Street, New York City, Aug. 13, presided over by Robert M. Gates of the Lakewood Engineering Co. The purpose of this section, as announced, is to "promote the art of the mechanical handling of all materials" and a general sentiment was expressed at the meeting in favor of co-operation with other organizations, including the Material Handling Manufacturers Association and the Society of Terminal Engineers, in the furtherance of this object.

W. L. Dickinson suggested that close co-operation should exist between the new section and the American Institute of Electrical Engineers on account of the relation of electrical equipment to mechanical material handling. F. M. Feiker, vice-president, McGraw-Hill Co., Inc., proposed that the section deal largely with the economies of material handling engineering rather than with the details of equipment and mechanical problems. Discussion developed proposals to include in the activities of the section consideration of broader phases of rail and water transportation, but the general sentiment was to confine activity to consideration of internal material handling problems. Shortage of common labor was emphasized as an all important factor.

A nominating committee of three members was elected to select one or more candidates each for the office of chairman, vice-chairman and secretary of the section, to be elected by letter ballot to the membership. These officers, constituting the Executive Committee, will when elected designate the time of the next meeting and special subjects to be discussed.

Boston Molasses Tank Cases on Trial

Trial of accident claim cases resulting from the collapse of an elevated tank filled with molasses, on Commercial St., Boston, on Jan. 21, 1919, has begun with the hearing of evidence before Col. Hugh. W. Ogden as auditor. The claims number over 100, but many of these have been consolidated for more rapid progress of the litigation. The amount of the claims is said to total $3,000,000. They are brought against the United States Industrial Alcohol Co., owner of the tank, and under the direction of the court the auditor is required first to determine the defendant's liability, the apportionment of damages being a subsequent step.

Duluth Ferry Bridge Declared Unsafe, To Be Inspected

A preliminary engineering report stating that the well-known ferry bridge at Duluth is unsafe led the city council on Aug. 2 to order a second inspection of the structure by an outside engineer. The report on the first inspection said, among other things, that many of the rivets are poorly driven, that the track rivets are in bad condition, and that parts of the bridge are rusting seriously.

Recommend Rebuilding of Weak Bridges in Indianapolis

If the position of the city's engineering department is upheld by the Board of Public Works of Indianapolis, Ind., a number of existing bridges that are too weak for modern traffic will be rebuilt before a new bridge is constructed. In reporting on a petition for the improvement of Twenty-first St., involving an important new bridge, J. C. Elliott, Assistant City Engineer, recommended that the petition be disapproved, as nine bridges elsewhere in the city are in dangerous condition and require rebuilding. One of the structures (Kentucky Avenue, over White River) may soon be posted for a three-ton maximum load. One or two of the other bridges have already been closed. A few of the canal bridges are very old wooden structures and in especially dangerous condition.

Contracts Let for County Court House in New York

Contracts exceeding $5,000,000 for a number of the main items in the construction of the new county court house were awarded by the Board of Estimate of New York City on Aug. 12: Steelwork, to Bethlehem Steel Bridge Corp., $1,280,000; brickwork and concrete floors, to D. E. Connor at $880,000 and $658,000; limestone, to H. Hanlien & Son, $2,372,000; roofing, to Hermann & Grace Co., $48,000. Guy Lowell, the architect for the court house, recommended that limestone be selected in place of granite for the facing, as being more than $100,000 cheaper and requiring less time to furnish; the limestone is to be furnished in 11 months and all of the cutting is to be done within the city. The foundation work had been awarded previously to Rogers & Hagerty, for $1,900,500.

American Work for Swiss Tunnel

A contract for pneumatic concrete mixing plant for lining the water tunnel of a hydro-electric development in the Alps has been secured by the Concrete Mixing & Placing Co., Chicago. The tunnel will be 4¾ mi. long, of horseshoe section 9½ ft. high and 9 ft. wide, with a lining 10 in. thick in rock and 20 in. in soft material. The contractors are John Reusch & Sons, St. Gallen, Switzerland.

City To Pay Claims for Discharge of Public Service Engineers

Claims of engineers employed by the Public Service Commission, New York City, for services given to the city on a volunteer basis during January, 1919, are to be paid if the Board of Estimate adopts a resolution just submitted to it by Comptroller Craig. On Jan. 1, 1919, part of the engineering staff of the Public Service Commission was discharged because no appropriation for their services had been made by the Board of Estimate. However, a number of the discharged employees continued at work, volunteering their services in order to keep the subway planning and construction operations going until the beginning of February, when an appropriation was passed by the Board of Estimate. For these volunteer services claims upon the city were submitted by the employees in question. These claims, totaling 39 in number, cover periods of service ranging from three to thirty-one days and amount to a total of $5,462.90.

In presenting the resolution for payment of these claims, Comptroller Craig reviews the conditions leading up to the failure of the appropriation on Dec. 30, 1918, and the various elements of lack of harmony between the Board and the Commission, including failure of the Commission to submit its request for appropriation in such form that the moneys involved could be allotted to their respective construction and operation contracts, as provided by law. He then cites the volunteering of service by the dismissed employees and says:

"Unquestionably the City of New York has received the full benefit of their services. Because of the action of the Public Service Commission, however, no legal liability exists to make payment for such services. The Public Service Commission in their public announcement of Dec. 31, 1918, stated that they were laying off from duty 323 employees because of the reasons aforesaid. It turned out, however, that by actual count the number of employees so laid off for alleged lack of appropriation was not 323 but 39. I, therefore, certify that such claims are and each of them is illegal and invalid as against the City of New York, but that notwithstanding such illegality and invalidity it is in my judgment equitable and proper for the City of New York to pay the amounts of the said several claims, the sum specified being the amount of compensation in each case that the several and respective employees would have received had there been no interruption in their tenure of service."

It is expected that this resolution will be passed promptly by the Board of Estimate, and that thereby the unfortunate situation existing at the time mentioned, described in *Engineering News-Record* of Jan. 9, 1919, p. 112, may be finally cleared.

Forest Products Laboratory Holds Decennial Celebration

Over 200 visitors attending the decennial celebration of the U. S. Forest Products Laboratory at Madison, Wis., represented lumber and wood-working associations and companies, forestry schools, the U. S. Forest Service and other interests. In an address on "Legislative Measures for Forest Conservation," Governor Philipp of Wisconsin took the position that reforestation is not a state duty but the duty of the national government, since timber grown in any one state is distributed throughout the country. Colonel W. B. Greeley, chief forester, U. S. Forest Service, said that the policy should be not to use less wood but to grow more by using the idle acres of burned and logged-off timber lands.

Dr. Birge, president of the University of Wisconsin, spoke of developments for combined technical and industrial research. C. P. Winslow, director of the laboratory, explained its purposes and the wide scope of its work, and estimated that this work represented an annual value of $30,000,000 in increased production and decrease of waste. Following the celebration there was a conference on reforestation, a meeting of the technical committee of the National Lumber Manufacturers' Association, and a meeting of deans of forestry and engineering schools.

Hool and Johnson Form Consulting Engineering Firm

George A. Hool, of Madison, Wis., and Nathan C. Johnson, of New York City, have announced the formation of the firm of Hool & Johnson, engineers, with offices in New York, Milwaukee and Cleveland. Associated with them is the laboratory and engineering staff of the James H. Herron Co. of Cleveland. Mr. Hool is professor of structural engineering at the University of Wisconsin and is the author of a number of text-books; Mr. Johnson for some years has been in consulting practice in New York City, specializing in the technique of concrete manufacture. The two have also been associated in the authorship of well-known text-books on concrete and have another book on building construction now in the press.

The new firm will undertake designs, plans, estimates, contracts and specifications, supervision of construction of all kinds in concrete, steel, and other materials, as well as the inspection, testing and use of construction materials, researches, investigations and development of industrial processes and new industrial matters. In this work it will operate in conjunction with the laboratory of the Herron Company. Service is also offered in examinations and reports, consultations, adjustments and arbitration, and as counsel in engineering and patent cases of various kinds.

Baltimore to Vote on $51,000,000 for Public Improvements

The City of Baltimore, Md., will submit to the voters early next month three loans to be used for public improvements, as follows:

(1) Port improvements, $10,000,000; this being the first installment of a total $50,000,000 loan authorized by the Maryland Legislature.

(2) Water supply improvements, $15,000,000.

(3) General improvements, such as street paving and sewers, $26,000,000.

The administration of these loans, according to information received from Henry G. Perring, chief engineer, Department of Public Improvements, will be handled by two commissions appointed from the citizens, the Port Improvements Commission handling the port and harbor improvements and the General Improvement Commission the other loans. In commenting upon the character of the appointees to these new bodies Mr. Perring says:

"It is interesting to note that Baltimore has in the past recognized the value of engineers at the head of commissions or boards. Thus we find the harbor engineer is president of the Harbor Board, the water engineer is president of the Water Board, the consulting engineer is head of the Paving Commission; all these being bodies that have been functioning in the city for many years. In the new commissions, Mayor William F. Broening has recognized the value of engineers to the city, and the ordinance authorizing the commissions provided that the harbor engineer should be ex-officio a member of the Port Improvement Commission, and the chief engineer of the city an ex-officio member of the Public Improvement Commission."

The engineers of the community and the public at large, says Mr. Perring, are particularly gratified that Mayor Broening has appointed as head of the Port Development Commission J. E. Greiner, consulting engineer, of Baltimore.

Bidding on Preliminary Survey for Delaware River Bridge

On Aug. 12 the engineering committee of the Delaware River Bridge and Tunnel Commissions of New York and Pennsylvania held a hearing at which architects and engineers discussed the cost and time of a "preliminary survey" for the proposed Philadelphia-Camden bridge. J. A. L. Waddell, C. W. Leavitt, Henry Goldmark, Joseph M. Huston, Sanford Lewis, Henry B. Seaman, Ralph Modjeski, J. L. Harrington and others conferred with the committee. Offers were made to carry out the "survey" for less than $100,000 and complete the work within six months. At the close of the hearing the committee requested all the engineers and architects interested in the case to submit definite proposals during the following week in order that the committee might make a recommendation as to what engineers should be employed to do the preliminary work.

Rumors in well informed circles are to the effect that a board of engineers will be formed to carry on the bridge design and construction. It is not known, however, whether this same board will conduct the preliminary engineering. George S. Webster, chief engineer of the Bureau of Surveys of Philadelphia, is prominently mentioned for a leading place on the board.

Mills Adopt New Weight Standards for I-Beams and Channels

A new table of standard weights for minimum sections of I-beams and channels has just been adopted by the Association of American Steel Manufacturers, according to an announcement issued by J. O. Leech, secretary. By the change, the well-known weights current since 1896 are altered to bring them into agreement with the standard dimensions of the shapes; a 9-in. 21-lb. I-beam, for example, now becomes a 9-in. 21.8-lb. I-beam, and the latter weight corresponds to the published dimensions of this minimum 9-in. beam, under the standard methods of computation of weights and areas.

To summarize the history of the standardization briefly: In 1896 the association adopted a list of standard profiles of structural steel sections. Fifteen years later it adopted standard methods of computation for published weights and areas. The weights that were published for the minimum thicknesses of beams and channels did not correspond exactly to the published areas, and it has long been known that it is impracticable to furnish these sections true to both the published weights and dimensions.

To correct this situation the Association has now adopted as American standards the weights per foot shown in the last column of the table below for the sections of minimum web thicknesses which do correspond to the published dimensions.

Depth, Inches	— Weight, Pounds per Foot — Present Weight	New Weight
	I-BEAMS	
3	5.5	5.7
4	7.5	7.7
5	9.75	10.0
6	12.25	12.5
7	15.0	15.3
8	18.0	18.4
9	21.0	21.8
10	25.0	25.4
12	31.5	31.8
12	40.0	40.8
15	42.0	42.9
15	60.0	60.8
15	80.0	81.3
18	55.0	54.7
20	65.0	65.4
20	80.0	81.4
24	80.0	79.9
24	105.0	105.9
	CHANNELS	
3	4.0	4.1
4	5.25	5.4
5	6.5	6.7
6	8.0	8.2
7	9.75	9.8
8	11.25	11.5
9	13.25	13.4
10	15.0	15.3
12	20.5	20.7
15	33.0	33.9

There is to be no change in the profiles and properties of sections of minimum web thickness, nor in the weights and properties of the intermediate and maximum sections. The new weights are to be put into effect Sept. 1 by all of the companies rolling these sections.

Portland Cement Engineers Hold Seminar in Seattle

Western district engineers of the Portland Cement Association were called to a seminar in Seattle on Aug. 16-18 to discuss engineering problems in which cement is a factor, particularly the construction of concrete highways. District engineers were to be in attendance from Los Angeles, Denver, San Francisco, Helena, Portland and Seattle. In addition the meeting was to be attended by C. N. Reitze, western district manager, Seattle; William M. Kinney, general manager, Chicago; A. N. Johnson, consulting highway engineer, Chicago; and C. R. Ege, engineer of Road Bureau, Chicago. In conjunction with the meeting there was scheduled an inspection of several hundred miles of concrete roads in Washington, including a number of jobs where construction is under way, and typical aggregate producing plants.

Chicago Officials Indignant at Engineering Society's Attitude

Under the heading "Thompson Backs Francis Against the Engineer Clan," the Chicago *Post* reports that the civil service commissioners are indignant at the sharp resolution adopted by the local chapter of the American Association of Engineers on the dismissal of two bridge engineers from the city employ (resolution noted in this journal Aug. 12, p. 334). The report states that Mayor Thompson will ignore the resolution of the chapter demanding the removal of the civil service commissioners and C. R. Francis, commissioner of public works. That the resolution did not lack in effect is indicated by the statement in the report that Joseph Geary, one of the commissioners in question, "waxed warm as he discussed the resolution of the engineers."

Kerckhoff Tunnel Holed Through

On July 27, the Kerckhoff tunnel, which is to supply the new Auberry (Cal.) plant of the San Joaquin Light & Power Corp., was holed through in the tangent between north portal and adit 1. With this step fully two months have been gained on the original schedule. Work began in June, 1919. The tunnel is 18,000 ft. long and 17 x 17 ft. in section. As described in *Engineering News-Record* of Feb. 12, p. 314, the work was attacked from a number of headings, reached from the portals and two adits.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Holyoke, Mass., Sept. 7-10.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Sept. 13-17.

SOUTHWEST WATER WORKS ASSOCIATION, Waco, Tex.; New Orleans, La., Sept. 20-23.

AMERICAN ASSOCIATION OF PORT AUTHORITIES, Montreal; Chicago, Sept. 30-Oct. 2.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; St. Louis, Oct. 10-15.

The Southwest Water Works Association will hold its ninth annual convention Sept. 20 to 23 at the St. Charles Hotel, New Orleans, La. In addition to the presentation of papers, there will be round-table talks and a series of short talks on difficulties and how they were overcome. E. L. Fulkerson, Waco, Tex., is secretary.

The New England Water Works Association will hold its 39th annual convention at Holyoke, Mass., Sept. 7-10. Sessions will be held Tuesday afternoon and evening, and three a day on Wednesday and Thursday. The preliminary program lists about 20 papers and half a dozen committee reports as scheduled for presentation, with the probability of several papers being added. Friday afternoon will be devoted to a "Superintendents' Session," at which papers on practical problems will be read.

PERSONAL NOTES

THEODORE SPEIDEN, JR., has been appointed division engineer maintenance of way of the Baltimore & Ohio R.R., with headquarters at Philadelphia.

HOWARD MURRAY, vice-president of the Shawinigan Water & Power Co., has been elected a member of the board of directors of the Dominion Bridge Co., Montreal. During the war he was chairman of the Explosives Committee, Imperial Munition Board, at Ottawa.

GERARD H. MATTHES, for the past five years hydraulic engineer with the Miami Conservancy District, has been appointed assistant engineer in the U. S. Engineer Office at Chattanooga, Tenn., where he will have immediate charge, under Major Harold C. Fiske, of the investigation of the Tennessee River provided for in the River and Harbor Act. The investigation will cover the future development of the river for navigation and will be made with special reference to water powers, flood control and the mineral resources of the upper Tennessee basin in so far as these can be expected to have an influence on navigation on the Tennessee River and its navigable tributaries. Mr. Matthes' experience covers 25 years in hydraulic engineering, of which 11 have been in hydropgraphic work, municipal and irrigation engineering, 7 in hydro-electric and 7 in flood control work.

C. O. FOSS, chief engineer of the St. John & Quebec Ry., St. John, N. B., has been appointed one of the three members constituting the newly created Hydro-Electric Commission of New Brunswick.

RALPH R. BENEDICT, formerly assistant superintendent of parks of Kansas City, Mo., and for the past two years with the Ordnance Bureau of the War Department at Washington, D. C., has been appointed assistant to the chief highway engineer of the State of Illinois, Department of Public Works and Buildings, Division of Highways.

S. B. GINN, principal assistant engineer of the railroad department of Brier Hill Steel Co., has been appointed office engineer for the Ohio region of the Erie R.R., with headquarters at Youngstown, Ohio.

A. B. EATON has resigned as city engineer of El Dorado, Kan., to accept a position with the Brown-Crummer Bond Co., of Wichita, Kan. He will represent them on a paving contract at Bartlesville, Okla.

T. S. BOSWELL has been made assistant to chief engineer maintenance of way and structures of the Southern Ry., Lines East, with headquarters at Charlotte, N. C. He was recently superintendent, at Asheville, N. C.

ALEX MILNE, superintendent of water-works of St. Catherines, Ont., has been elected president of the newly formed Canadian section of the American Water Works Association. R. L. Dobbin, superintendent of water-works of Peterboro, Ont., has been elected secretary of the section.

W. G. CHACE, chief engineer of the Greater Winnipeg Water District from 1913 to June of this year, when he resigned to organize Research & Development, Ltd., a Manitoba corporation purposing to initiate new industries in that province based on its resources and on such other commercial enterprises as might offer opportunity of success, has been appointed president and manager of the Canadian Lock Joint Pipe Co., with headquarters at Toronto.

H. B. LARNER, the new health officer at Montclair, N. J., is a graduate of Massachusetts Institute of Technology, Department of Biology and Public Health. Following graduation in 1918 he became a member of the U. S. Public Health Service and for a year was stationed in the South engaged in rural sanitation studies, e[pi]demiological investigations and oth[er] public health work. For the past ye[ar] he has been health officer for Gold[s]boro, N. C.

R. T. DAVIS has been promote[d] from the position of assistant eng[i]neer of the Erie R.R., to that of divi[s]ion engineer at Huntington, Ind., su[c]ceeding J. R. Sexton, recently mad[e] regional engineer.

M. HIRSCHTHAL has been appointed concrete engineer on the Dela[ware], Lackawanna & Western R.R. with headquarters at Hoboken, N. J. He suceeds A. Burton Cohen, whose resignation was recently noted in these columns.

OBITUARY

HENRY GOUGH STANTON, for the past six years in the service of the Department of Railways and Canals, on the Ontario-St. Lawrence canals, at Cornwell, Ont., died in that city, Aug. 9, aged 65. Prior to going to Cornwall he was engaged in railroad work in Mexico, as well as on the trans-continental railways, and also as resident engineer on the St. Peter's Canal on Cape Breton. He was born in the City of Quebec.

WILLIAM PIERSON FIELD, consulting engineer, Newark, N. J., died at Llewellyn Park, West Orange, N. J., Aug. 8. He graduated from Princeton University in 1883 and took a post-graduate course in the University of Stuttgart, Germany. Aside from supervising the erection of many manufacturing plants in the vicinity of Newark, Mr. Field designed and supervised the building of the First Regiment Armory in that city and armories in Camden, Paterson, Jersey City and Trenton.

BUSINESS NOTES

THE CONCRETE MIXING & PLACING CO., Chicago, has resumed business on the return from war service of its president, H. B. Kirkland. The company may be addressed at 123 W. Madison St., Chicago.

G. F. WICKES, formerly sales and construction engineer for the Pittsburgh-Des Moines Steel Co., Des Moines, Iowa, and H. C. WICKES, formerly assistant engineer for the Pittsburgh office of the above-named company and later chief engineer for the Stacey Manufacturing Co., Cincinnati, have organized the Wickes Engineering & Construction Co., of Des Moines, to handle the construction of elevated tanks and towers, standpipes, oil tanks, bridges and culverts.